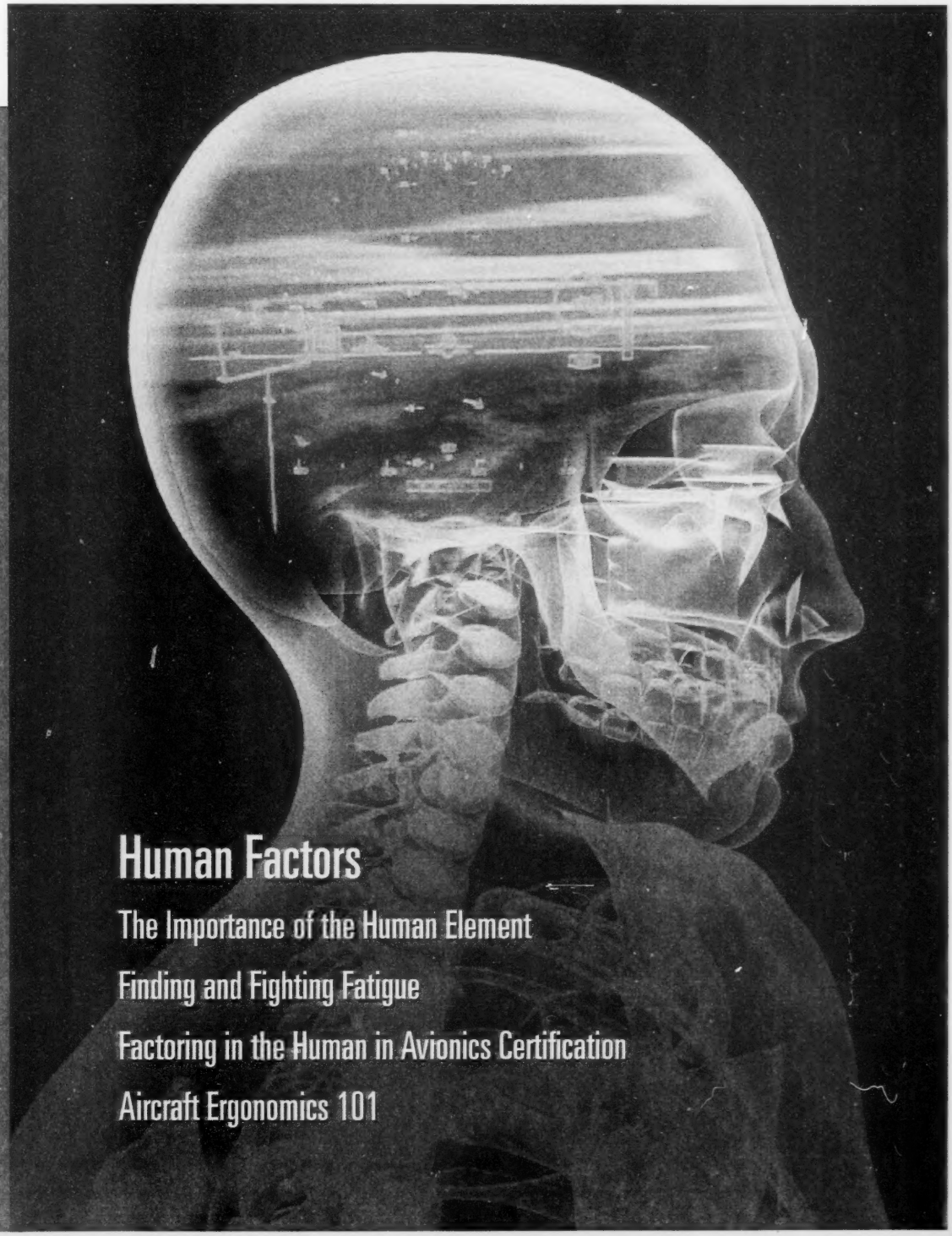
FAA Aviation News

SAFETY FIRST FOR GENERAL AVIATION

January/February 2010



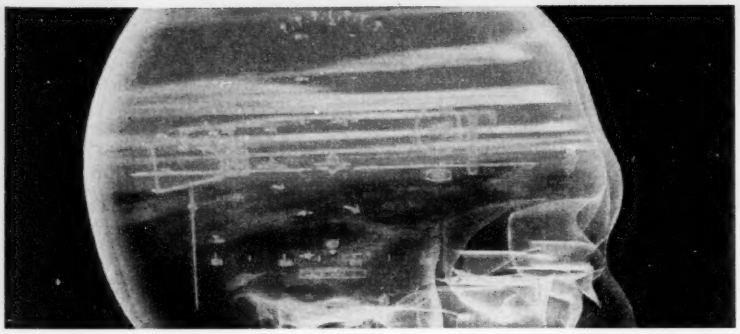
Human Factors

The Importance of the Human Element

Finding and Fighting Fatigue

Factoring in the Human in Avionics Certification

Aircraft Ergonomics 101



In this issue, we focus on the critical role human factors play in aviation safety. Articles address fatigue, decision making, aircraft design and technology, and more.

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JOHN M. ALLEN
DIRECTOR, FLIGHT STANDARDS SERVICE

Jumpseat

Pilots, Professionalism, and Priorities

"Don't confuse getting paid to fly with being a professional pilot."

That's what Captain Gene Cernan, NASA (Ret.), told us at the *Bombardier Safety Standdown.* I attended *Standdown* last October, along with FAA Administrator Randy Babbitt and hundreds of other pilots who traveled to Wichita to improve their piloting performance, knowledge, and understanding.

Bombardier holds *Standdown* every year to address improving human performance in the cockpit. Expert speakers present seminars on topics applicable to all pilots—whether you're in a one-seat Pitts for fun or in a corporate jet for your job. Bombardier and the speakers develop the seminars based on Dr. Tony Kern's Airmanship Model. Dr. Kern's model, detailed in his book *Redefining Airmanship*, is widely acclaimed. The book outlines ten elements of airmanship excellence and adheres to Kern's conviction that individuals vary greatly and "one-size-fits-all" programs are doomed to produce marginal results.

Redefining Airmanship is one of several excellent resources on how to address the human element and improve performance and professionalism across the aviation community. In this issue's "Checklist" column, Editor Susan Parson writes about the Aviator's Model Code of Conduct developed by Michael Baum. FAA endorses the Aviator's Model Code of Conduct in its *Aviation Instructor's Handbook* and explains that the code is not a standard, but it is a personal commitment to professional development and continuing education.

Through the extensive research he did to produce the Airmanship Model, Dr. Kern identified a number of challenges to improving airmanship. For general aviation pilots, he has said the certification requirements "do little to inspire an aviator to seek high levels of personal achievement. Once a particular rating or certificate is obtained, the external motivation is gone, unless one seeks a higher certification or rating or is lucky enough to have mentors or peers to inspire them to higher goals."

Dr. Kern addresses these challenges head on through his model. All ten principles center on the individual—on you, on me, and on everyone who climbs into a cockpit, picks up a wrench, fuels a plane, controls traffic, or does a host of activities across the aviation community. Airmanship requires individual skill, proficiency, judgment, commitment, and, just as, or more, important, a professional approach and attitude. These are all human factors, which is the focus of this issue of *FAA Aviation News.*

At the *Standdown* I heard a number of experts and, like Captain Cernan, they talked about professionalism, about discipline, and about making a personal commitment to improvement. Yet, the person who expressed it best, and, yes, this could come across as brownnosing, was FAA Administrator Randy Babbitt, who was speaking from 14,000 hours of experience. He said, "If you're an aviation professional, you've got to do the right thing even when no one else is looking; *especially* when no one else is looking."

Don't confuse getting paid to fly with being a professional pilot.

We must do the right thing, the best thing, each and every time. Our lives, the lives of our loved ones, just may depend on it.

In short, be a professional. Make it a priority to take advantage of the many resources available, such as this publication, the Aviation Learning Center at www.faasafety.gov, and our own Safety Stand Down the FAA Safety Team will hold on April 17.

I look forward to seeing you there.

ATIS

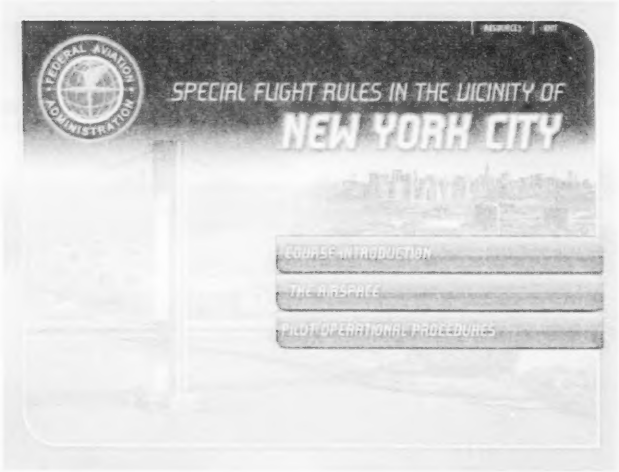
Aviation News Roundup

Special Flight Rules Training Now Available for New York City

On November 19, 2009, FAA published changes to Title 14 Code of Federal Regulations part 93, Special Air Traffic Rules, that modify New York airspace over the Hudson and East rivers. The changes, based on recommendations of the New York VFR Airspace Task Force, are designed to create a safer, dedicated operating environment for all aircraft that fly at lower altitudes around Manhattan.

A new online training course, available through www.FAASafety.gov, gives pilots a thorough overview of the revised rules. The non-mandatory course, titled "Special Flight Rules in the Vicinity of New York City," takes about 20 minutes to complete. Pilots can receive WINGS credit for the course and will have the option of printing a completion certificate.

"We encourage all pilots planning to fly in this area to register and take the course," says FAA Aviation Safety Inspector Mark Giron, who helped develop the training. "It's a great opportunity for pilots to become more familiar with the new rules and also gain a better perspective of the revised structure of this busy airspace."



Beware of Carburetor Icing

In the November/December 2009 issue of *FAA Aviation News*, several articles addressed the dangers of structural icing and how it can impair aircraft performance. Hidden inside your engine, however, is another icy danger—carburetor ice. According to NTSB, carburetor icing was a factor in 212 accidents between 1998 and 2007. These included 13 fatal accidents.

Carburetor icing is caused by the sudden cooling of humid air aided by the vaporization of fuel as it flows through the intake. This freezing condition can occur quite rapidly and cause ice to clog the carburetor intake. In some cases, the intake flow can be restricted enough to stop the engine.

Carburetor ice can be detected by a drop in rpm in fixed-pitch propeller airplanes and a drop in manifold pressure in constant-speed propeller airplanes. In both types, usually there will be a roughness in engine operation. A pilot's first response when encountering carburetor ice should be to apply full carburetor heat immediately. Engine roughness is expected for a short period as the ice melts.

"It's important to remember that carburetor icing doesn't just happen during the winter months," warns Aerospace Engineer Peter Rouse of the FAA's Small Airplane Directorate. "If there is high humidity or visible moisture, carburetor icing can occur at temperatures well above freezing." In general, carburetor ice will form in temperatures between 32-50°F when the relative humidity is 50 percent or more.

To prevent carburetor icing, pilots should:

- Assure the proper functionality of the carburetor heat during the before-takeoff check.
- Use carburetor heat on approach and descent when operating at low power settings, or in conditions where carburetor icing is probable.

For more information on carburetor icing, reference Special Airworthiness Information Bulletin CE-09-35 at http://www.faa.gov/aircraft/safety/alerts/SAIB/.

Photo by Jeff Johnson

A Piper* Cherokee, *one of the aircraft affected by the proposed AD.

Proposed Piper Airworthiness Directive Addresses Control-wheel Shafts

On October 30, 2009, FAA issued a Notice of Proposed Rulemaking (NPRM) to propose adopting an Airworthiness Directive (AD) to detect and correct an issue with control-wheel shafts on certain Piper airplanes (PA-28, PA-32, PA-34, and PA-44 series). The AD stems from two field reports of control-wheel shafts that were assembled incorrectly at Piper—one of which led to a separation of the control wheel from the shaft. Piper issued Service Bulletin 1197A on September 1, 2009, which provides instructions on the inspection and replacement procedure.

If implemented, the AD would require an inspection of the control-wheel shaft on both the pilot and co-pilot side, and replacement of the shaft if necessary. FAA estimates 41,928 airplanes in the U.S. registry would be affected and that an estimated repair/replacement cost would be $1,430 per airplane. The comment period on the NPRM closed on December 29, 2009.

Master Pilot and Mechanic Award Winners Featured in "Roll of Honor"

Did you know that recipients of the prestigious Wright Brothers Master Pilot Award and Charles E. Taylor Master Mechanic Award are recognized in the "Roll of Honor" available online at www.faasafety.gov? Click the "Award Programs" link from the main page to access the list of award recipients, as well as to find details on each of the programs.

To be eligible for either award, candidates must have at least 50 years experience in their respective industry, a positive safety record with no FAA certificate revocations throughout their career, and three letters of recommendation from their peers. Refer to FAA FS-I-8700-2 for more information on the Master Pilot Award and AC-65-26D for the Master Mechanic Award. Award winners receive a certificate, plaque, and a pin, which are typically presented at an FAA or industry event.

Standing Down for Safety on April 17, 2010

"Military and civilian flight organizations have long recognized the value in 'standing down' from operations in order to dedicate a day to safety," says Marco Grillo of the FAA Safety Team (FAASTeam).

"That's exactly what the FAASTeam is doing on April 17, 2010—standing down for a day to focus on safety," Grillo adds. Scheduled in conjunction with the Sun 'n Fun Fly-in and Convention, the start of the busy spring/summer flying season, the first FAASTeam Safety Stand Down will focus on four theme areas: loss of control, surface safety, owner-performed maintenance, and risk management.

"Our research of GA accidents and incidents shows that by focusing on these four areas we can most 'move the needle' to improve GA safety," said FAASTeam data manager Eric Minnis. "Our National Resource Center is developing programming on these areas that we'll present at Sun 'n Fun. In addition, the programming will be available live on the Web to make it available across the country."

The FAASTeam numbers some 128 FAA safety professionals and more than 2,000 volunteer representatives across the United States who develop targeted programs to improve safety. The National Resource Center in Lakeland, Florida, supports FAASTeam managers and representatives with a host of safety education products. The biggest product is its Web site at: www.faasafety.gov. Sign up today to get more information about the FAASTeam Safety Stand Down and to be notified about other FAA-sponsored events and seminars.

Aeromedical Advisory

FREDERICK E. TILTON, M.D.
FAA FEDERAL AIR SURGEON

Keeping Fit for Flight

Pilots are taught to follow the "IMSAFE" checklist to evaluate their mental and physical fitness before each flight, but how do pilots get and stay fit? FAA offers a brochure titled "Fit for Flight" (http://www.faa.gov/pilots/safety/pilotsafetybrochures/media/FitFor_Flight.pdf) that provides some basic information for pilots on how to adopt and maintain a flying-friendly healthy lifestyle.

Get with a Program

While you don't need the body of a professional athlete in order to fly, maintaining strength and flexibility is important. Muscles that aren't used tend to atrophy and weaken—even that big one in your right leg that helps you keep the airplane on the centerline during takeoff. A healthy cardiovascular system helps you avoid potentially life-threatening conditions, such as heart disease and diabetes. One of the other important benefits of physical fitness is that your body is better prepared to cope with the various emotional and physical stressors that are encountered while flying.

Of course, we'd be remiss if we did not remind pilots to check with a physician before beginning any exercise program. If your FAA Aviation Medical Examiner (AME) is also your primary care physician, he or she may even be able to tailor a program to your specific needs and flying lifestyle.

Eat Right, Fly Smart

The "Fit for Flight" brochure suggests that pilots who want to improve their overall diet eat well-balanced meals that offer a combination of proteins, fats, and carbohydrates. Keep your energy up, but avoid eating a big nap-inducing meal right before a flight. While many studies have shown that moderate consumption of alcohol can be good for your heart and possibly reduce the risk of some types of cancer, pilots need to be mindful that the "eight-hour bottle-to-throttle" rule is the absolute minimum. Some individuals may require a longer period between drinking and flying depending on the amount of alcohol consumed and their personal metabolism.

Drinking enough water throughout the day is important for anyone, especially if you work out. Remember, dry air aloft can also make you thirsty, so always have bottled water available in the cockpit—and a good alternate in mind in case you or your passengers need a bathroom break.

IMSAFE Checklist

Before each flight, ask yourself the following questions:

Illness – Am I sick today? Am I coming down with a cold or other ailment?

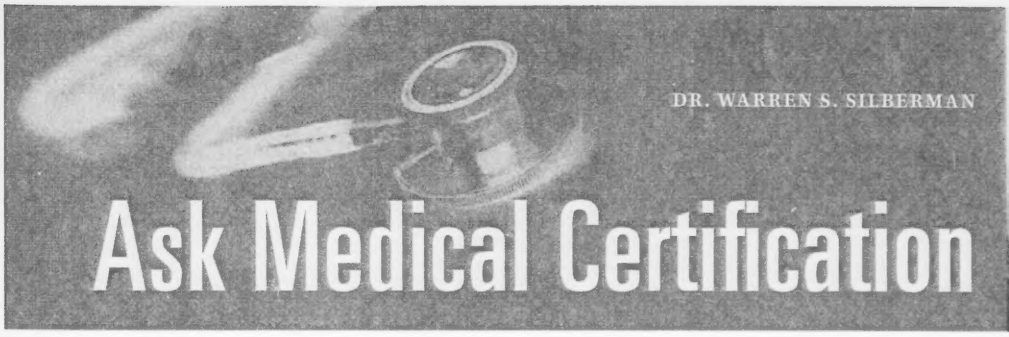
Medication – Am I taking any medications that would impair my ability to act as PIC?

Stress – Am I under a lot of stress right now (work, family, or other pressures)?

Alcohol – Have eight hours, or more, elapsed since I last consumed alcohol? (See 14 CFR section 91.17)

Fatigue – Have I had enough rest or am I feeling sleepy?

Eating – Have I had enough to eat or am I feeling hungry or thirsty?



DR. WARREN S. SILBERMAN

Ask Medical Certification

*Starting with this first issue of 2010, we are pleased to present a new department that may quickly become the "go-to" part of each magazine: "*Ask Medical Certification,*" by Dr. Warren Silberman. Dr. Silberman (featured in the January/February 2009 "FAA Faces" column) is manager of FAA's Aerospace Medical Certification Division (AMCD) in Oklahoma City, Oklahoma, which administers the aeromedical certification program for about 600,000 holders of U.S. pilot certificates and processes 450,000 applications each year. Silberman is sharing some of the frequently asked questions and answers on medical certification in this new column. If you have questions for Dr. Silberman to address in future columns, send them to the magazine staff at Aviation News@faa.gov, and we'll gladly forward them on a totally confidential (anonymous) basis.*

Q: Does the FAA have an approved list of medicines that pilots may take, specifically ARICEPT®? I take it as a preventive measure since I have a family history of Alzheimer's disease.

A: When the FAA considers a medication as being acceptable for medical certification it first of all considers whether the medical condition that the medication is being used for is not disqualifying. There are medications that are absolutely unacceptable, such as narcotic pain medications, but there is no list of medications. ARICEPT® is an unacceptable medication as is the medical condition Alzheimer's.

Q: At my last physical, my doctor expressed concern about my high blood pressure reading of 150/90. He told me to exercise more and reduce the amount of salt in my diet. Is this something I need to discuss with my aviation medical examiner (AME) immediately, or can it wait for my next exam?

A: Part 61.53 clearly states that if an airman develops a known disqualifying medical condition, or a known disqualifying medication or treatment, he/she must not fly. Our AMEs are instructed that if an airman comes into their office for an FAA examination and a solitary blood pressure reading is greater than or equal to 155/95 they may not issue a medical certificate. At a minimum, you should notify the FAA at your very next medical examination. High blood pressure is a disqualifying medical condition, but you can be granted medical certification, and in this particular condition without an authorization for Special Issuance [waiver]. This is because high blood pressure (hypertension) can be treated and most antihypertensive medications are acceptable for flying.

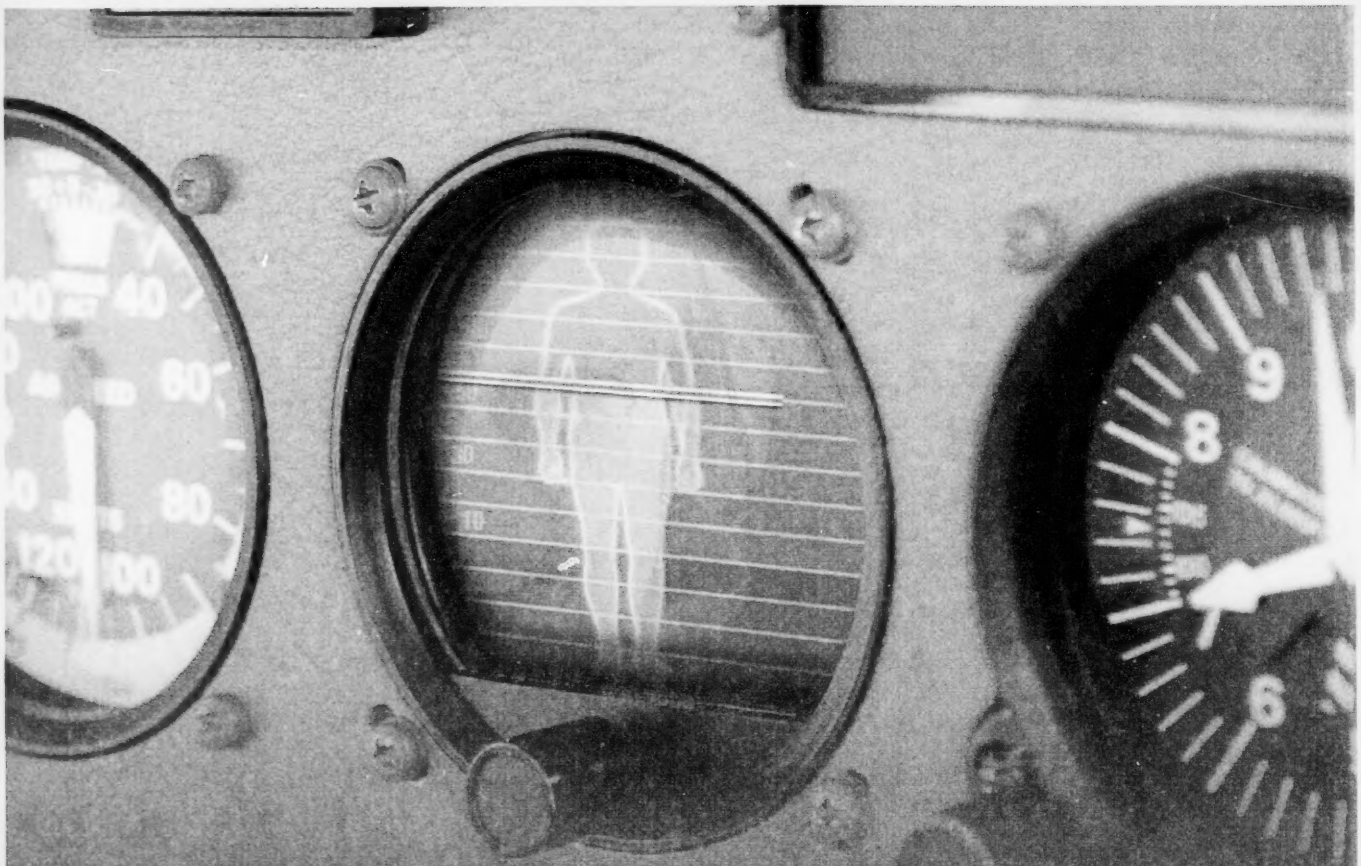
For more information, see the hypertension section of the Online Guide for Aviation Medical Examiners at: http://www.faa.gov/about/office_org/headquarters_offices/avs/offices/aam/ame/guide/dec_cons/disease_prot/hypertension/.

Q: How soon can you reapply after being denied a Class III medical certificate? I stopped taking the disqualifying drug (Mirapex) after my denial. When can I apply again?

A: The medication Mirapex is used mainly in the treatment of Parkinson's disease. It has a side effect of causing one to fall asleep without warning. It is an unacceptable medication. Once your physician removes you from the drug, FAA would like to see what being off the medication does to your medical condition. You should likely be off the medication several months before you attempt to gain back your medical certificate. You may need to start a new medication that will delay the recertification. The FAA will require a detailed note as to when the medication was discontinued and how the medical condition is currently behaving.

Send your question to Aviation News@faa.gov. We'll forward it to Dr. Silberman without your name and publish the answer in an upcoming issue.

Warren Silberman, D.O., M.P.H., manager of the FAA's Aerospace Medical Certification Division, joined the FAA in 1997 after a career in the U.S. Army Medical Corps. Dr. Silberman is Board Certified in Internal Medical and Preventive/Aerospace Medicine. He is a Fellow of the American Osteopathic College of Internists, American Osteopathic College of Occupational and Preventive Medicine, and the Aerospace Medicine Association. He is a private pilot with instrument and multi-engine ratings and holds a third-class medical certificate.



The Importance of the Human Element

THOMAS R. CHIDESTER AND CARLA A. HACKWORTH

We have all experienced moments where we are left scratching our heads trying to figure out "what just happened?" Have you ever been distracted while taxiing? Have you ever planned your flight, checked weather, and yet inadvertently encountered IMC? Have you ever read back a clearance incorrectly? If so, you have likely thought about what happened and how you can prevent it from happening in the future. That means, whether you realized it or not, you were thinking about human factors and aviation, the very theme of this issue.

What Does "Human Factors" Mean?

The events described above may or may not have human limitation as a root cause, but most require addressing human factors to prevent similar occurrences.

The discipline of human factors addresses how people interact with technology, co-workers, machines, and the work environment to safely accomplish tasks. FAA focuses its human factors research on how pilots, controllers, dispatchers, AMTs, flight attendants, and ground personnel safely and effectively do their jobs. For example, FAA works with designers when new systems are planned and implemented to help do three things:

1. Facilitate appropriate use
2. Prevent mistakes
3. Watch for unintended consequences.

When errors do occur, FAA human factors experts try to understand the factors that led to those errors. One important goal is to determine whether a given error is a one-time problem or a potential pitfall for other people.

Here are some topics and examples of how FAA human factors researchers work to help you avoid many of the common human errors made by pilots.

It Could Have Been Me...

Researchers designed a flight simulator exercise that asks the pilot to plan a trip from Amarillo to Albuquerque. The pilot prepares by reviewing aviation weather online, and then calls Flight Service for a briefing. There are visual meteorological conditions (VMC) at both airports. Clouds are moving across the planned route of flight at various altitudes, but ceilings and visibility are acceptable for flight under visual flight rules (VFR).

The pilot departs for Albuquerque as planned. Flight Watch reports that en route conditions are mostly as forecast. Still, it becomes clear that rising terrain and a decreasing ceiling while approaching the mountains east of Albuquerque will squeeze the flight from below and above. Descending to stay below clouds puts the pilot uncomfortably close to terrain, so he decides to divert to another airport. Executing a turn while tuning and identifying a navaid, he inadvertently enters instrument meteorological conditions (IMC). The aircraft impacts terrain as he exits the cloud.

What was the point of the exercise? The researchers were checking the effectiveness of weather training products. They exposed pilots to different types of training and then put them into challenging situations like the one described above to examine how they prepared and then how they performed when weather deteriorated. Everyone walked away with lessons learned. Unfortunately, many GA accidents have followed a similar path, but without a second chance for pilots to learn from their mistakes. How would you improve your preparedness or performance in this scenario?

The Benefits of Experience

We have all read accident reports where serious risk that is clearly apparent in retrospect went unnoticed by the pilot. Research provides one possible explanation for this behavior: We are more likely to accept multiple risks if we encounter them in a series, instead of all at once. Consider this example. Of course, you would not plan to take a VFR-only airplane into a high-altitude airport when visibility is deteriorating. But would you recognize yourself in that scenario if you had just lost a navigation radio en route to that airport and found yourself in marginal visibility?

In another example, human factors researchers developed a simulator study involving pilots of varying experience levels, with an equal number of instrument-rated and VFR-only pilots. The results are surprising. Although you might predict that experienced pilots would be more willing to forge ahead, the study actually found that more experienced pilots were more skeptical, less willing to fly the planned route under VFR, and more likely to divert and to maintain weather and terrain separation during flight. As stated in the *General Aviation Pilot's Guide to Preflight Weather Planning, Weather Self-Briefings, and Weather Decision Making* (available online at www.faa.gov), "the more doubtful the weather, the more information you need to obtain."

Research suggests that we are more likely to accept multiple risks if we encounter them in a series, instead of all at once.

Threat and Error Management

Training for today's airline pilots includes many lessons learned from human factors research. One topic that gets considerable attention is the concept of "threat and error management," or TEM. TEM recognizes that even when flights are planned and operated by trained and professional pilots in collaboration with dispatchers, mechanics, flight attendants, and others, human beings still make mistakes, especially when the environment presents challenges. The idea behind TEM is to accept this reality and train pilots to recognize errors as quickly as possible and manage, or mitigate, their negative impact.

Human factors research has contributed to what we know about the impact of workload on pilots.

Seeing Is (Not Always!) Believing

Many human factors specialists focus on the limits of perception. Guidance from research in perception is part of today's pilot training materials. Remember those lessons on visual and vestibular

(motion-sensing) illusions, differences in apparent glidepath as a function of runway dimensions, concerns about differences in color vision and visual acuity, and likely mistakes when flying in night or low visibility? Visual illusions still present great risks, so you may want to review some of the information available in FAA's brochure on this topic: www.faa.gov/pilots/safety/pilotsafetybrochures/media/SpatialD_Seeing.pdf.

Decision Making

Most theories of human decision-making assume a deliberative process: We gather information, consider alternatives, and select options that maximize benefit and minimize risk. Yet, researchers have observed that experienced pilots don't appear to do much deliberation. Instead, they use what one researcher calls "recognition-primed decisions." This means that pilots who think they understand a situation may believe the solution is obvious. The problem is things can go wrong if "recognition-primed decisions" lead to incorrect or inappropriate responses.

One study found that more experienced pilots were more skeptical and more likely to divert and to maintain weather and terrain separation during flight.

Here's an example. During the past two years, scientists have interviewed and analyzed the details of adverse weather encounters within a group of 25 pilots. They learned that the majority of these pilots did not understand or recognize the danger that the adverse weather would cause. The situations they encountered simply did not appear very different from other marginal situations they had successfully flown through before. The human factors lesson is this: Be wary. Always question your assumptions and strive for the key elements of good decision making. These include good information, knowledge to understand that information, and experience.

Workload

Human factors research has contributed to what we know about the impact of workload on pilots. As any pilot knows, many things can happen during very brief periods of each flight that can increase the likelihood of error. In too many accidents and incidents, the pilots get "behind" the aircraft, become controlled by changing circumstances, or rush to comply with conflicting duties.

Research has taught us that human beings are limited as information processors. When overloaded, we tend to shed duties and accept a less planned or controlled approach to what we do. These "normal" reactions can create unacceptable, but unrecognized, risk in flight. Human factors research in this area has therefore stimulated development of workload-reducing tools and systems for the cockpit to help keep pilots planning and thinking "ahead" of the aircraft.

Pros and Cons of Technology

Advances in technology can bring unintended consequences. In 2004, researchers found that pilots with access to higher-resolution NEXRAD weather images were more likely to try navigating between areas of heavy precipitation in a simulation study. This response was not the intended use of the system, which was designed to help pilots give significant weather a wide berth. In 2008, another researcher demonstrated that a very brief training program could prevent most pilots from making this mistake.

Photo by H Dean Chamberlain

These are just a few of many examples of how human factors—how you—can have a very real impact on safety. As human factors researchers, our goal is to improve the aircraft you operate, the training you receive, the equipment and support you are provided, and the environment in which you operate. To learn more about research at CAMI, visit: www.faa.gov/library/reports/medical/oamtechreports/.

Thomas R. Chidester, Ph.D., is Manager, Human Factors Research Division at FAA's Civil Aerospace Medical Institute. Prior to joining FAA in 2007, Dr. Chidester was with NASA as Director, Aviation Performance Measuring System and previously was Manager, Human Factors and Safety Training, American Airlines.

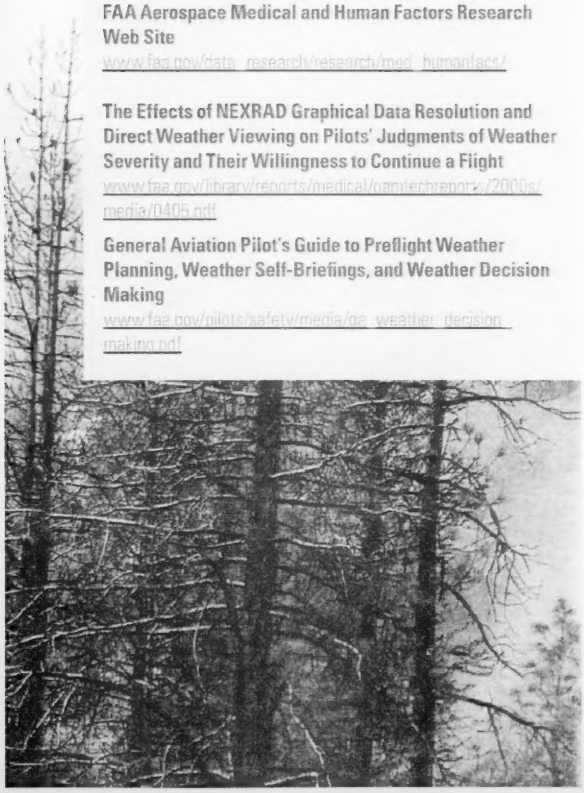
Carla A. Hackworth, Ph.D., is Manager, Flight Deck Human Factors Research Branch at FAA's Civil Aerospace Medical Institute. She has led assessments of organizational effectiveness, GA testing issues, weather-related GA incidents, and human factors in aviation maintenance.

For More Information

FAA Aerospace Medical and Human Factors Research Web Site
www.faa.gov/data_research/research/med_humanfacs/

The Effects of NEXRAD Graphical Data Resolution and Direct Weather Viewing on Pilots' Judgments of Weather Severity and Their Willingness to Continue a Flight
www.faa.gov/library/reports/medical/oamtechreports/2000s/media/0405.pdf

General Aviation Pilot's Guide to Preflight Weather Planning, Weather Self-Briefings, and Weather Decision Making
www.faa.gov/pilots/safety/media/ga_weather_decision_making.pdf



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WILLIAM B. JOHNSON
AND KATRINA E. AVERS

Finding and Fighting Fatigue

Pilot and controller fatigue has been making aviation headlines in recent years, punctuated by the February 2008 incident in which the crew of a regional jet fell asleep at the controls on the way to Hilo, Hawaii. Although it's usually airliner mishaps that make front page news, general aviation pilots are subject to the same fatigue-related risks and potential for disaster.

Consider this example and ask yourself (honestly) if it seems familiar: After a full workday in a distant office, a pilot flies his/her aircraft home and shoots an instrument approach to minimums at night. Or, the flight instructor who agrees to take just one more student after a full day of flying, pushing the limits of Title 14 Code of Federal Regulations section 61.195, which prohibits instructors from teaching more than eight hours in a given 24-hour period.

The solution is amazingly simple, yet often difficult to implement: Get more sleep.

Fatigue is part of our workaholic American culture, which is known for too much of the wrong food, too little of the right exercise, and insufficient or poor quality sleep. Pilots are not immune to developing such bad habits. In its annual sleep survey for 2009, the National Sleep Foundation found that 20 percent of Americans sleep fewer than six hours and that only 28 percent sleep more than eight hours per night. We report more sleep than we actually get, so the data perhaps underestimates the actual amount of sleep loss experienced by most Americans.

In the spirit of "know your enemy," human factors research is making progress toward making us wiser in the wearying ways of fatigue. The FAA offers a brochure for pilots titled "Fatigue in Aviation," which offers some useful tips on staying healthy and alert, but each pilot needs to be aware of his or her own unique habits and physiological limitations.

Develop Better Sleep Habits

- Get eight hours of sleep each night
- Get into a bedtime schedule and routine
- Turn off the lights and sound
- Make your bed a comfortable sleeping environment
- Cool room is preferred
- Avoid exercise right before sleep
- No caffeine (half-life of caffeine is six hours, so quit early)
- Do not eat two to four hours before sleeping
- Alcohol is not good for sleep

Avoid Becoming a Headline

As a pilot, one of the best ways to avoid becoming an NTSB accident statistic is to ask yourself, "If this flight goes badly, what would the NTSB report say about me? How would the headline read the next day? 'Sleep-Deprived Pilot Avoids Fatigue Warning Signs and Crashes, Killing All.'" If it's bad, maybe you should reconsider flying and take a nap.

When there is an accident, an incident, or a close call, trained investigators seek to determine

the cause in an effort to prevent such events from happening again. The best investigations identify not just the obvious cause, but rather the numerous factors in the overall chain of events.

The following are a list of simple questions that investigators may ask during an incident or close-call investigation. Pilots can benefit from pondering these questions before they leave the ground, to assess whether they are suffering from fatigue that could lead to an embarrassing incident or a deadly accident.

Example of Investigative Fatigue Questions for Work Task Mishaps (adapted for GA operations)

- How long were you awake prior to the mishap?
- How long was your last "major" sleep period (more than two hours sleep) prior to the work task mishap?
- How much additional sleep did you obtain through nap(s) since your last "major" sleep period?

HOW TO COUNT SLEEP*

Sleep is the **only** cure for fatigue. Many of us overestimate the amount of sleep we get each night. If you have difficulty falling asleep, wake up during the night, or wake up not refreshed, keep a sleep log to count how much sleep you really get each night.

Step 1: Complete the following log over a two-week period. For the period **MON**/*TUE*, indicate your **bedtime** Monday night and your *wake time* on Tuesday morning. Treat other time periods similarly. Indicate your bedtime and wake time on the bolded day if you obtain your sleep within one day (e.g., Monday for **MON**/*TUE*).

	MON/*TUE*	**TUE**/*WED*	**WED**/*THU*	**THU**/*FRI*	**FRI**/*SAT*	**SAT**/*SUN*	**SUN**/*MON*
Week 1 **Bedtime**							
Wake time							
Total Sleep Time							

	MON/*TUE*	**TUE**/*WED*	**WED**/*THU*	**THU**/*FRI*	**FRI**/*SAT*	**SAT**/*SUN*	**SUN**/*MON*
Week 2 **Bedtime**							
Wake time							
Total Sleep Time							

Step 2: Calculate your average sleep time (add your total sleep time in each column and divide by 14).
Step 3: Subtract 30 minutes from your average sleep time (to account for time it takes to actually fall asleep and wake up).
Step 4: If your adjusted average sleep time is fewer than eight hours, reevaluate your plan for sleep.

Average Sleep _____ Adjusted Average Sleep _____

Step 5: Keep this record and revisit your sleep schedule every three months.

*For additional information on this chart go to www.mxfatigue.com.

Fatigue Mitigation for Air Carrier Pilots

In June 2009, FAA chartered an Aviation Rulemaking Committee to develop recommendations for rulemaking on flight time limitations, duty period limits, and rest requirements for Title 14 Code of Federal Regulations part 121 and part 135 pilots. The committee completed its work in September. As of this magazine's publication deadline, a rulemaking team was evaluating the committee's recommendations and developing a Notice of Proposed Rulemaking (NPRM) on fatigue mitigation for part 121 pilots. While this effort is aimed at air carriers, all areas of aviation will benefit from a spotlight being shone on the fatigue risk factor, which affects all sectors of aviation and all pilots from students through ATPs.

- How much did you sleep in the 24 hours prior to the work task mishap?
- How much did you sleep in the 72 hours prior to the work task mishap?
- How many hours did you work in the five days prior to the work task mishap?

Squeezing in More Sleep

Avoiding fatigue is not rocket science, yet we as humans continue to challenge conventional sleep wisdom by drinking too much caffeine, consuming too much refined sugar, not getting enough exercise, and engaging in other sleep-preventing behaviors, all while working long hours often under great stress. Our jobs have reduced the requirement for extensive physical work, and child's play is now more likely to involve a computer game than a ball field. This vicious cycle drives us to exercise less, eat more, and sleep less—and the cycle continues.

Although air carrier pilot fatigue-related mishaps make the headlines, GA pilots are subject to the same fatigue-related risks.

The solution is amazingly simple, yet often difficult to implement: Get more sleep. Humans need about eight hours of sleep in a 24-hour period. It takes about 15 minutes in bed to fall asleep, and your last 15 minutes of sleep is not healthy, restorative sleep. That means that you should spend eight and a half hours in bed, dedicated to sleeping, each night. Don't allow television, radio, or food in bed. If you miss sleep one night then you must sleep extra the following night to catch up. If you want to avoid fatigue, these simple rules are not negotiable.

If you are uncertain of your sleep duration, then you should try keeping a sleep diary. This may be the first advice you would get from a clinical sleep professional. The FAA developed a chart (see previous page) that you can use to track your sleep patterns over a 14-day period. Do you need more sleep? Go to www.mxfatigue.com and find out.

Numerous scientific studies have matched the performance of fatigued drivers to the performance of drunk drivers. The next time you are awake for 20 hours straight remind yourself that your performance level is equivalent to that of a legally drunk driver. Fatigue can affect not only your ability to drive the car, but your decision to drive in the first place. Should you be flying an airplane when you are in that condition? Write the next day's page-one headline in your head, and then lay it down on your pillow to sleep.

William B. Johnson, Ph.D., is FAA Chief Scientific and Technical Advisor for Human Factors in Aircraft Maintenance Systems. He joined FAA in 2004 after 30 years of private sector experience in academia, safety engineering consulting, and airline/MRO training. He is an Aviation Maintenance Technician and a 40-year pilot.

Katrina E. Avers, Ph.D., is a research scientist in the Human Factors Research Division at FAA's Civil Aerospace Medical Institute. Her research focuses on organizational assessment, fatigue education, fatigue reporting systems, and fatigue risk management programs for flight crew, cabin crew, and maintenance technicians.

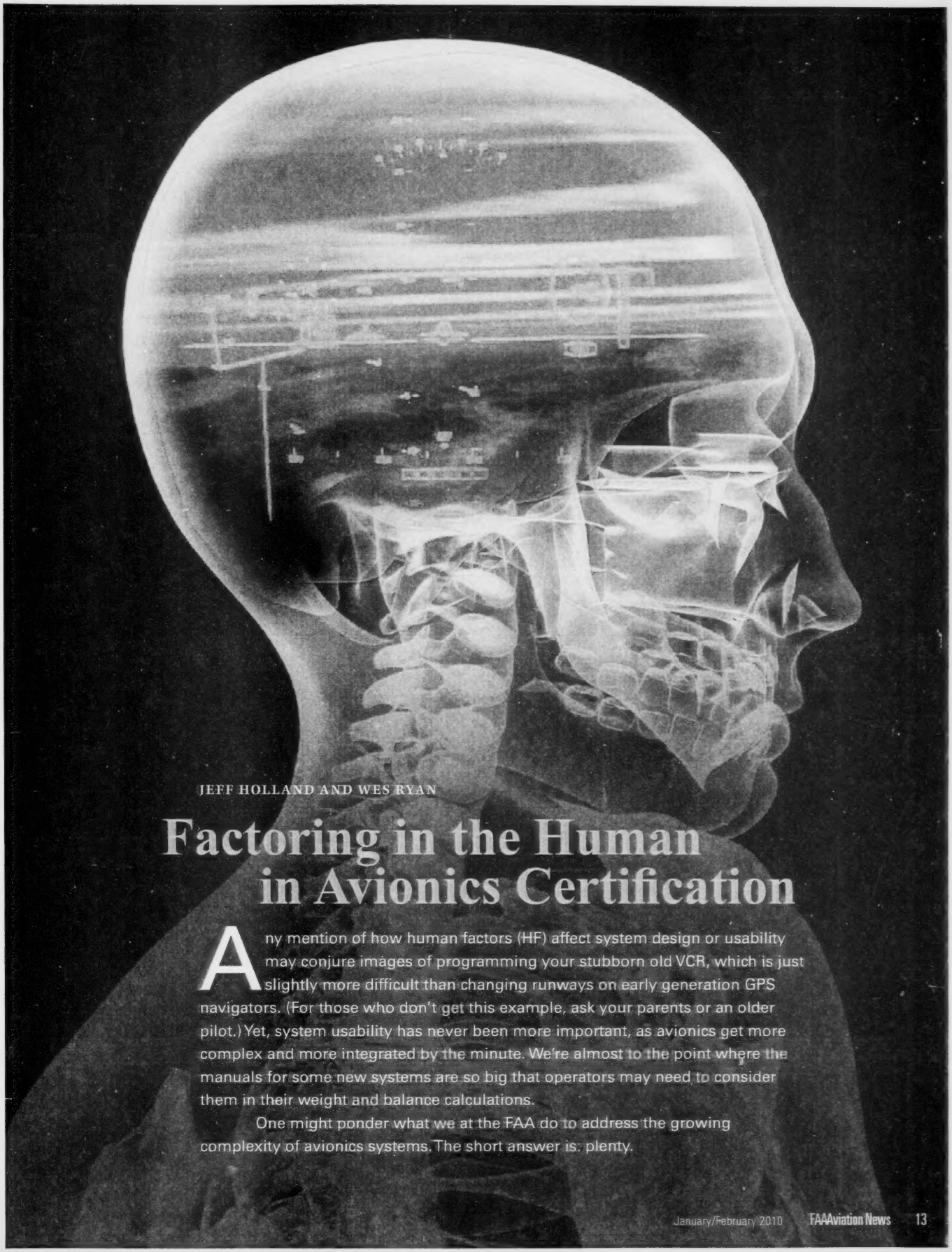
For More Information

FAA Fact Sheet on Pilot Flight Time, Rest, and Fatigue
http://www.faa.gov/news/fact_sheets/news_story.cfm?newsId=6762

Fatigue in Aviation
http://www.faa.gov/pilots/safety/pilotsafetybrochures/media/Fatigue_Aviation.pdf

Fatigue Section of the Maintenance Human Factors Web Site
http://hfskyway.faa.gov/HFSkyway/FatigueHome.aspx

Proceedings from FAA Aviation Fatigue Management Symposium, June 17–19, 2008
http://www.faa.gov/news/conferences_events/2008_aviation_fatigue/

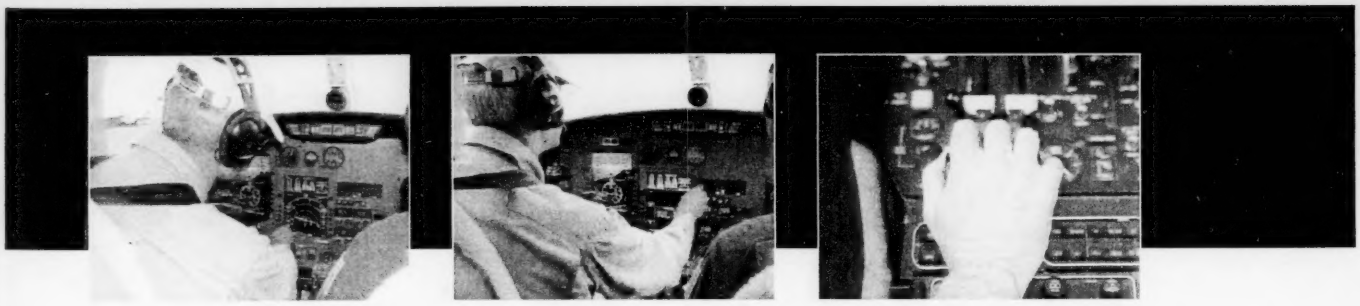


JEFF HOLLAND AND WES RYAN

Factoring in the Human in Avionics Certification

Any mention of how human factors (HF) affect system design or usability may conjure images of programming your stubborn old VCR, which is just slightly more difficult than changing runways on early generation GPS navigators. (For those who don't get this example, ask your parents or an older pilot.) Yet, system usability has never been more important, as avionics get more complex and more integrated by the minute. We're almost to the point where the manuals for some new systems are so big that operators may need to consider them in their weight and balance calculations.

One might ponder what we at the FAA do to address the growing complexity of avionics systems. The short answer is: plenty.



Starting with the Human

FAA has HF specialists, flight-test pilots, and engineers who review and certify every new major avionics product seeking technical standard order (TSO) and/or installation approval. It may not be widely known, but FAA HF evaluations typically start very early in the product development cycle, often with the first prototype in a company's laboratory. These early HF evaluations check basic physical characteristics, including control interface and display characteristics. The areas we concentrate on include: intended function, display appearance, symbology, color palette, menu structure, menu depth and complexity, knob/button size, labeling, and system usability.

Menu structure, knob shape, and labels are very important because pilots expect obvious and easy-to-recognize functions with a clear and distinct tactile feel. Pilots expect their actions to result in intuitive and obvious system responses. They also expect clearly displayed options with an obvious means of selection and a clear way to return to a standard or default condition. Our early HF evaluations tell us how close to this mark new systems are.

As the system matures and designers add more capability and functionality, FAA evaluates the extent to which users have the ability to select options, view information, and input data. These part-task evaluations look at performance of single distinct tasks with the system, such as entering a navigation frequency, changing a barometric setting, or entering a simple flight plan. FAA HF specialists record their findings, identify any non-compliance, and provide feedback to the company. This cooperative process should occur early in the company's design process, when it is easier and less costly to make changes to the system.

Testing, Testing, and More Testing

Once the system has achieved some level of maturity and represents the end product, the company installs it into an airplane to begin in-flight evaluations. This may represent the first time anyone evaluates display dynamics and system interface in the airplane, so there are usually additional items to evaluate. At this point, FAA conducts additional evaluations to assess system usability under actual flight conditions.

In cases where the system is highly integrated, complex, and/or performs critical functions, FAA uses a formal evaluation process that involves scenario-based evaluations by multiple FAA pilots. The process, termed multiple pilot system usability evaluation (MPSUE), has become a standard approach to evaluating complex avionics systems targeting general aviation aircraft.

The FAA does not conduct MPSUEs on every product seeking certification. Neither is it our intent to do an in-depth human factors study on every aspect on every new system or component. Instead, we make an initial assessment of the complexity, novelty, and potential for controversy based on the system characteristics or functions. Next, we assess the potential impact each aspect may have on pilot awareness, performance, workload, and, ultimately, safety. Based on these findings, we make a determination whether we need a MPSUE and how in-depth and rigorous it needs to be to mitigate risks and ensure a safe usable product. We have conducted MPSUEs with as few as three pilots and as many as seven pilots.

We select the test pilots based on their training, background, and experience to fly canned scenarios representative of the types of VFR and IFR environments and situations general aviation pilots may encounter. The evaluation scenarios include situations that will expose pilots to various system aspects, including failure conditions, and require them to exercise system functions. Our HF specialists collect data from individual pilots throughout the flight using questionnaires and rating forms. At the conclusion of testing, participants gather together to discuss results and draw conclusions. All the findings are shared with the company. The benefit to the company and end user is a product that is easier to learn, easier to use, and subsequently safer.

The process sounds simple, but it takes a very special mix of skills to conduct, including knowledge of human behavior, human performance, required piloting skills, and an understanding of system design philosophy.

Keeping Eyes on the Prize

FAA is not interested in whether a new product is the "best on the market." Instead, our goal is to make sure the system meets all the pertinent regulations, performs its intended function reliably, is intuitive to use, and is safe. While we don't expect different products to function, look, or feel exactly the same to the pilot, we do strive to bring a level of standardization to the process. Pilots should be able to acceptably operate and use a system with minimal training.

The good news is that companies are beginning to recognize the benefit of getting the human factors experts involved early in the development and certification process. Many of the aircraft and avionics manufacturing companies have hired their own human factors experts. For those smaller companies that do not have the finances or resources to hire their own human factors experts, FAA steps in to ensure those companies consider the users' capabilities and limitations throughout the design and development process.

Considering all the amazing technology making it into the panel these days, such as touch screens, voice-activated flight management systems, and other novel user interfaces, a proper HF evaluation has never been more important. There is nothing worse than developing a new gadget that few can use.

Ultimately, our avionics manufacturers agree that, even if the process is a little painful, it results in a better, more user-friendly product in the end. The next time you slide into that rental airplane with its vast array of advanced avionics or purchase that new avionics component, rest assured that a lot of thought and time went into the design of that box with you in mind. It's not a perfect process; sometimes we just plain miss something. But, we take HF work very seriously as do the manufacturers. Yet, even with all this great HF effort in the design and approval process, pilots still must learn their systems to fly safely and must have a clear understanding of a system's functions and limitations.

Jeff Holland is the human factors specialist and Wes Ryan is the manager of the FAA Small Airplane Directorate's Programs and Procedures Branch.

Calling All Mechanics

Keep Informed with

FAA's Aviation Maintenance Alerts

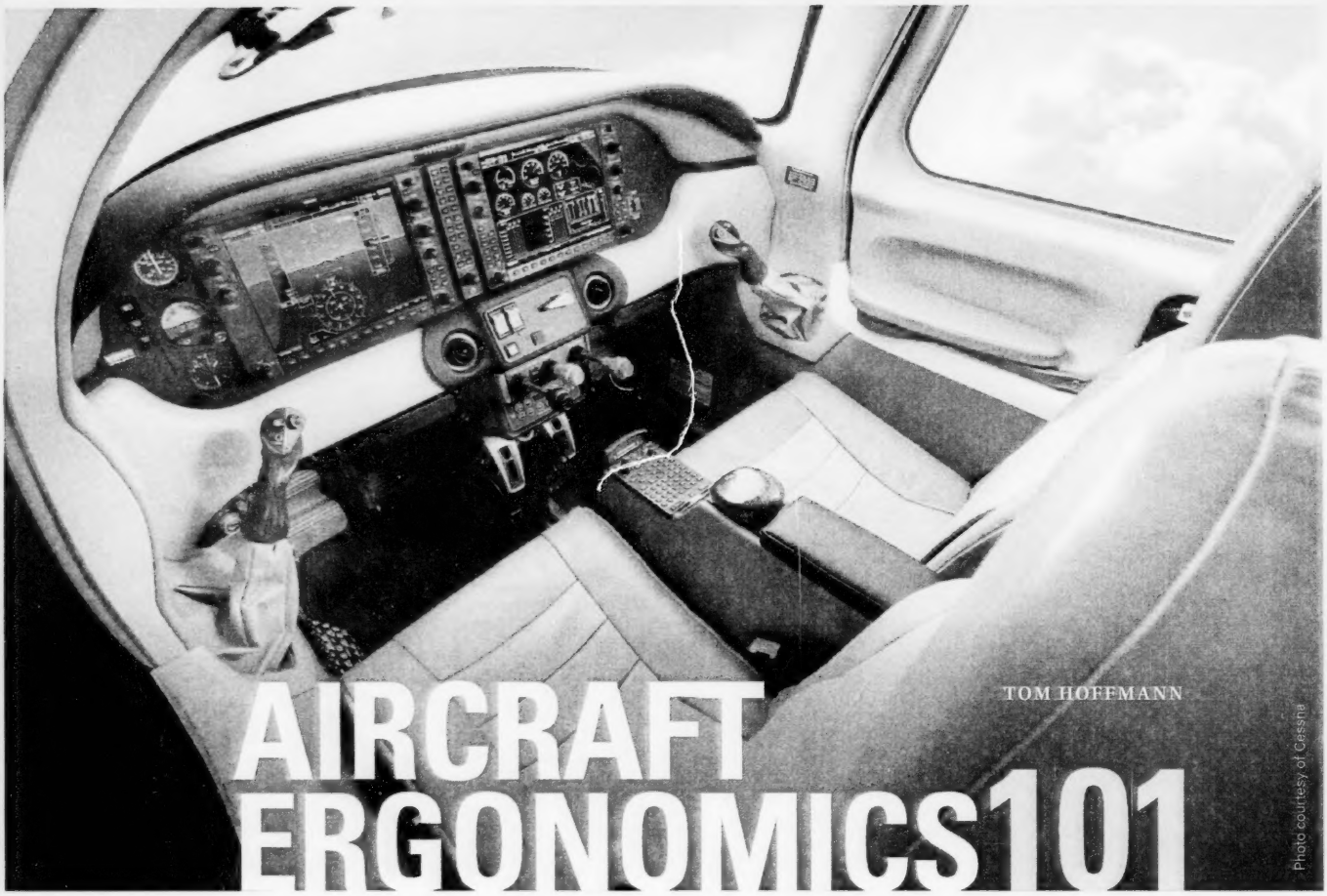
Aviation Maintenance Alerts (Advisory Circular 43.16A) provide a communication channel to share information on aviation service experiences. Prepared monthly, they are based on information FAA receives from people who operate and maintain civil aeronautical products.

The *Alerts*, which provide notice of conditions reported via a Malfunction or Defect Report or a Service Difficulty Report, help improve aeronautical product durability, reliability, and safety.

Recent *Alerts* cover:

- Elevator torque tube inspection warning on the Cessna 208B
- Stuck anti-ice valve on the Beech 390
- Flap motor wire bundle chafing on the Cessna 172R

Check out *Aviation Maintenance Alerts* at:
http://www.faa.gov/aircraft/safety/alerts/aviation_maintenance/



AIRCRAFT ERGONOMICS 101

TOM HOFFMANN

Photo courtesy of Cessna

The complex business of integrating man and machine

Comfort is overrated in flying, right? For years, a strongly-held mantra of function over form, as well as a hazy understanding of how people and planes truly interact, has kept many a pilot behind the "comfort and design" curve. Scientific research and manufacturing ingenuity have helped narrow that gap and continue to improve aircraft design by focusing more on the human element of flying.

Although many GA pilots expect their flight experiences will still involve a certain amount of discomfort, such as exposure to noise or extreme temperatures, or maybe even some awkward appendage contorting to reach certain controls, there are many more options available now to help mitigate those distracting elements. And, of course, with increased comfort comes an increase in productivity, and more importantly, safety. Welcome to the world of aircraft ergonomics.

If even the most intuitively designed device or process does not feel comfortable, its success will be limited.

We've Come a Long Way

Many might think that ergonomics, or human factors engineering, is strictly for designing office chairs, fancy kitchen appliances, or the latest exercise device. While it has its place in those industries, the discipline of ergonomics was born out of a need to design more efficient and pilot-friendly aircraft during World War II. A 1947 study by Paul Fitts, a human factors pioneer, analyzed a series of airplane accidents and how cockpit design contributed to their outcome. The study's findings helped lay the groundwork for a more ergonomic cockpit—one where pilots could reach all the controls as well as understand the increasingly complex array of dials and indicators.

Ergonomics, in its most basic sense, is the study of work, how it is done, and how it can be done better or more efficiently. It's also about making things more intuitive and easier to use. In a cockpit, the need for useful design is critical as a pilot's senses are bombarded constantly with

A few often overlooked ergonomics improvements: upgraded seats and a custom armrest with an adjustable side reading/map light.

external stimuli, each vying for attention. Keeping actions, functions, and controls within a logical, intuitive framework helps prevent these stimuli from distracting the pilot from the task(s) at hand.

But, let's not forget comfort. It's one of the greatest aspects of a design's effectiveness. If even the most intuitively designed device or process does not feel comfortable, its success will be limited.

Perhaps one of the greatest human factors breakthroughs in cockpit design has been with instrument displays. Evolving from the "Basic T" design of mechanically driven gauges, many airplanes now have electronic flight panels, or "glass" cockpits, that integrate controls and instruments within a series of color display panels.

"Integrated instrumentation represents a great advance toward simplifying the panel and reducing a pilot's scan pattern," says FAA/CAMI research engineering psychologist Dr. Dennis Beringer. "However, if not designed properly, these displays can become cluttered and difficult to interpret." The challenge in keeping the display simple is to emphasize the visibility of the most important pieces of information, such as airspeed and altitude, so pilots get a clear picture of what's happening from a common reference point.

Look at Garmin's latest integrated flight deck series, the G3000, for evidence of the important focus of intuitive visual design. The new avionics suite uses an innovative touch-screen design that works like an iPod® and allows pilots to get the information they need quickly and easily.

Yet, there's more than just what pilots see in the cockpit that influences their actions. It's also about what they feel and what they hear. This focus led to another important advance in ergonomic design: improved sound-proofing. During the boom of GA production in 1960s and 1970s, many aircraft used simple fiberglass insulation to fill the voids in door panels and between stringers and bulkheads. More modern aircraft now make use of materials such as acoustical foam and other more advanced decibel-dampening materials.

A more portable approach towards warding off noise fatigue can be achieved with a good headset. New technology has transformed the modern headset into a lighter, more comfortable

Photos courtesy of Airmod

design. Many also now come with active noise canceling, an advancement that provides protection against low-frequency noise, and can make even a piston-powered GA cockpit seem whisper quiet.

When it comes to tactile improvements, you don't have to look far to see how much more intuitive and functional many knobs, levers, switches, and controls have become. Consistent shape, size, color, and location all contribute to promoting greater efficiency, an important commodity when it comes to a cockpit's complex environment. See Title 14 Code of Federal Regulations (14 CFR) part 23 for FAA guidelines on cockpit control location and control knob shapes.

Finding out what works best for you to fine tune your optimal position may take some time, but it's worth the effort.

It's Personal

A closer look at ergonomics reveals that it addresses many of a human's basic and more universal needs, but also an individual's specific traits, characteristics, and physical dimensions. Therein lies the challenge for many aircraft designers. When it comes to cockpit dimensions, one size certainly does not fit all. In addition to complying with FAA aircraft design regulations, manufacturers typically follow what the automotive industry does, which is to design to a standard that appeals to the majority of the population, specifically the middle 90th percentile or 90 percent of the population.

While not a perfect solution, the costs of integrating design standards beyond that limit can far outweigh their benefit. Aircraft manufacturers must be aware, however, that human dimensions can change over time and are influenced by variations in lifestyle, nutrition, ethnicity, and other variables. According to U.S. National Health Examination Surveys taken in 2004, the mean height for both U.S. men and women increased one inch over the last five decades. Incidentally, that growth spurt was apparent in other directions, too, as results from those same surveys also showed adults gained an average of 24 pounds in the same period.

Airplane Makeovers

What if your airplane is getting on in years and doesn't boast many of today's creature comforts or cockpit enhancements? What's a pilot to do? There are several modification companies that specialize in turning an old, noisy, and creaky plane into something more enjoyable and comfortable to fly. Some of the changes you can make to your aircraft include:

- More comfortable seats
- Enhanced lighting
- More efficient or additional air vents

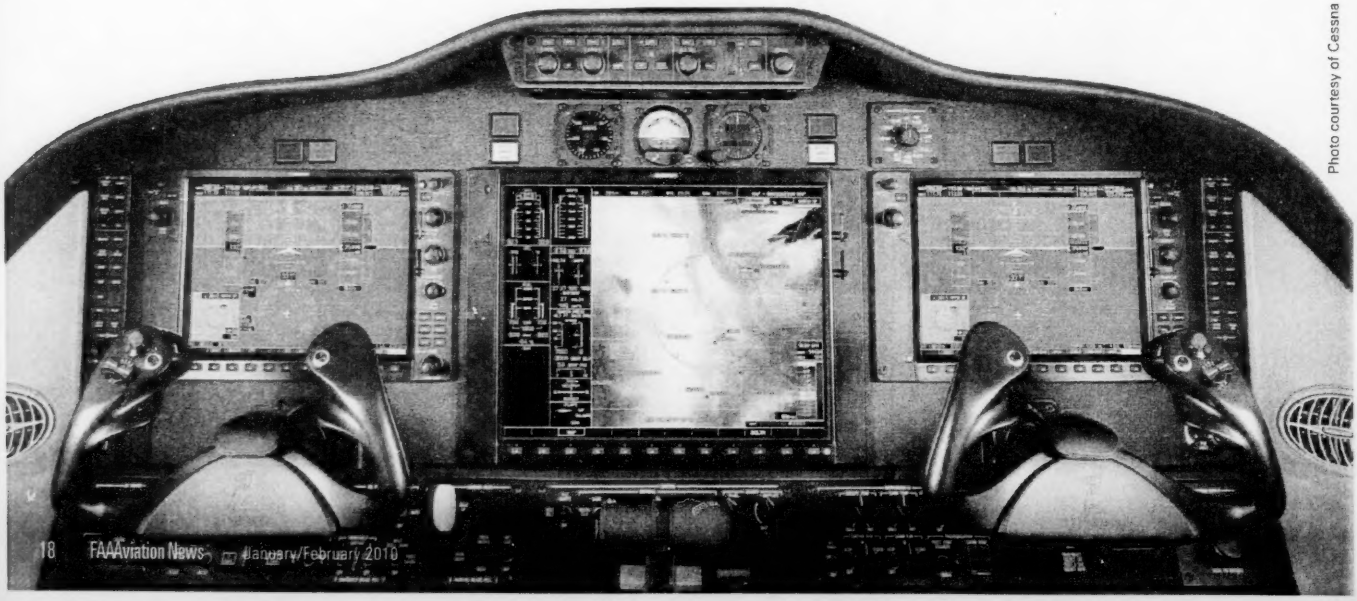


Photo courtesy of Cessna

- Passenger restraint systems and airbags
- More ergonomic armrests and side panels

"A good, supportive seat is one of the best investments you can make," says Dennis Wolter, President of Air Mod, a firm that specializes in custom aircraft modifications. "It's quite literally your connection to the aircraft." Wolter is also quick to point out a common misconception that soft and cushy equals comfort.

Finding the Perfect Fit

What if you don't own an aircraft? Or, what if it's not financially feasible for you to make updates? Not to worry, there's still plenty you can do without breaking the bank. For one, especially if you're a student pilot or flying a new make or model, don't take for granted the seat position is best for you the way it was left. Test out the range of motion for each seat control and see what works best for you. Can you reach the rudder and brake pedals properly? Can you reach all the controls properly, e.g., flaps, trim wheel, mixture, radios? Some pilots have a hard time finding or reaching the fuel selector valves. On certain aircraft these selector valves sometimes do not have a "both" setting and so realizing it's out of reach or out of sight mid-flight could cause some uneasy moments.

Something else to remember is to ensure that you have the proper sight line over the instrument panel. If you've maxed out the vertical seat adjustment and still feel low, try using a booster seat. They're available at many pilot supply stores and come in different variations of thickness. Booster seats work better than a pillow due to their firmness and rigidity. Finding out what works best for you to fine tune your optimal position may take some time, but it's worth the effort.

Sweat behind the Ears

Another good practice of promoting cabin comfort is being familiar with all the heating and ventilation controls. I recall my first primary flight instructor did not introduce me to the air vents of my *Cessna* 152. I spent my first few hours of training in the sweltering heat of summer unaware relief was just a wrist flick away. The stress of being a brand new student only compounded this uncomfortable feeling and kept me from speaking up. Later, another instructor opened a new world of comfort to me when he opened the air vents to blow cool and rejuvenating air on my face. What a difference! When the need arises, make sure you're using any and all available cooling and heating controls and that you can properly reach them, especially if you're in an unfamiliar aircraft.

The Eyes Have It

There's also the issue of protecting one of your most valuable pilot assets—your eyes. If your aircraft has sun visors, be familiar with them and make sure they work before your flight. I can recall on more than one occasion when the visors were either missing or snapped off and fell in my lap when I tried to move them.

A good pair of sunglasses is a good second line of defense and will also protect your peepers no matter where you look. Besides helping you look fighter-pilot cool, sunglasses also protect you from the sharp glare of direct sunlight, from flying debris, and from harmful UV radiation. (See "Aeromedical Advisory" in the July/August 2008 *FAA Aviation News* for more information on protecting your eyesight.)

A good, supportive seat is one of the best investments you can make.

Looking Ahead

Since the early days of flying, ergonomic design has grown tremendously. Its benefits have helped pilots and aircraft attain milestones in aviation once thought unattainable. And, while these enhancements may do a good job keeping your feet warm or providing back support, they also play the important role of combating fatigue, stress, noise, and other serious factors that if unchecked can degrade the performance of a pilot.

The next time you jump in the cockpit, take a close look at your environment and consider some things you can do to help yourself become more of an extension of that aircraft. Leveraging the benefits of ergonomics will help keep you flying safe for years to come. And, that's a comforting thought.

Tom Hoffmann is associate editor of the FAA Aviation News. *He is a commercial pilot and holds an A&P certificate.*

SUSAN PARSON

Checklist

Doing the Right Thing = Having the Right Stuff

An FAA colleague includes the following Michael Josephson quote as part of her standard e-mail signature line:

> *An ethical person ought to do more than he's required to do, and less than he's allowed to do.*

We focus in this issue of the magazine on human factors, and that quote certainly captures some of the core conundrums for us imperfect humans. In a world that too often condones "good enough" and too often encourages "just don't get caught" permissiveness, it is also a powerful reminder for aviators. Skills and practices characterized as "good enough" are never good enough for safety, and we often gain more—especially in questionable weather—when we do "less" than the rules and regulations permit. I also think of that sentence as the essence of what my boss, Flight Standards Service Director John Allen, wrote about the issue of professionalism in this issue's "Jumpseat" column. If you've been listening to the news lately, you know that FAA Administrator Randy Babbitt has been emphasizing professionalism as well.

The Aviator's Model Code of Conduct (AMCC) presents broad guidance and recommendations that general aviation pilots can use to improve airmanship and flight safety.

Flying to Code

So what is professionalism, and how do you put that seemingly abstract concept into practice? There are plenty of resources available, but here's one that you should consider adding to your flight bag and, more importantly, to your mindset: The Aviator's Model Code of Conduct.

Created by Michael Baum, a commercial pilot, author, attorney, and former Internet security executive and "organizationally neutral" in terms of its ownership and association, the Aviator's Model Code of Conduct (AMCC) presents broad guidance and recommendations that general aviation pilots can use to improve airmanship and flight safety, and to sustain and improve the GA community. There are several variants, but the basic AMCC document addresses:

1. General Responsibilities of Aviators
2. Passengers and People on the Surface
3. Training and Proficiency
4. Security
5. Environmental Issues
6. Use of Technology
7. Advancement and Promotion of General Aviation

Be the Best You Can Be

Each section of the AMCC provides a list of principles and sample recommended practices. In so doing, it presents a vision of excellence and professionalism that supplements what is merely legal. As Baum notes in the AMCC introductory material:

> The premise of this code is that ethics offers pilots an additional, systematic way to prepare for flying more safely. Ethics [...] complements all the regulations, instructional material, and experience we gain in aviation [and] a code of conduct based on ethics can keep pilots out of trouble. [...] It defines goals to help pilots improve their performance and achieve their potential. It clarifies community values and provides practical guidance for living by them. [...] Ethical behavior, constructive attitudes, and a positive culture add to safety for individual pilots and foster a healthy aviation community.

You can download the complete document (including kneeboard-friendly versions) from www.secureav.com. It is provided as a free public service to the aviation community. Read and heed!

Susan Parson is a special assistant in the FAA's Flight Standards Service. She is an active general aviation pilot and flight instructor.

DOUG STEWART

A Case of Denial

With broken to overcast skies, it was shaping up to be a perfectly gloomy day for providing training to my client on this, the third day of one of my "East Coast IFR Experience" trips. But the real gloominess of the day came not from the weather, but from the fact that my client was unprepared for his training.

As part of my flight training business, I offer these IFR trips to provide otherwise competent instrument pilots with valuable experience to help polish already developed skills and techniques. Instead, this time, I found myself teaching my client the basics of instrument flying. I was not looking forward to being in IMC with this client, as it would require my constant attention to ensure he maintained the proper headings and altitudes and remained somewhere close to the course we were cleared to fly.

Ignoring Signs of Risk

The filed route had us departing Asheville, North Carolina, and flying south across South Carolina, Georgia, and into Florida. By the time we reached Florida the skies were forecast to change from the stable but overcast skies that we encountered on departure to the typical afternoon convective activity usually found in the summer south.

I was not in a particularly chipper mood as I conducted the airplane preflight inspection under grey, damp skies. As always, I climbed up on my stool to check the fuel level in the tanks to verify that the lineman had indeed topped them off. I wanted to be sure that we had sufficient fuel for any potential diversion between Asheville and our first stop, Waycross, Georgia. The forecasts were definitely a good incentive for having plenty of fuel. Little did I know that my diversion would be for an entirely different reason.

Departing Asheville, we were quickly in the soup. All of my attention went to monitoring my client. As we made our way south, the smooth, but solid, IMC slowly started to change to broken skies with occasional light showers. At least the smoothness of the ride allowed my client to maintain a good attitude, not only with the airplane, but personally as well. As he slowly gained confidence I started to relax, and began to assess all the other things one needs to be aware of when flying, particularly when in the clouds.

Practicing what I preach, I asked myself the two most important questions we must always be able to answer: Where am I, and, what's next? Our groundspeed was pretty much as planned, and a little over a half hour into the flight we were about even with Greenville, South Carolina. With a clearance direct to the Alma VORTAC it would be quite some time before we would have to make a turn. It was also a little premature to load and brief the approach.

The next thing to do was to check all the engine instruments. As I scanned the gauges I was a bit surprised to see that the left fuel tank gauge showed three quarters full. "Hmm... that's strange," I thought to myself. We hadn't been flying long enough to have burned off seven and a half gallons of fuel. "I'll have to keep an eye on that," I thought, as I switched the fuel selector to the right tank.

As we flew along, passing in and out of broken stratus clouds and light showers, I checked the fuel totalizer. It confirmed that we were indeed consuming fuel faster than normal. To my amazement, it said 34 gallons per hour. Even more incredulous was my next thought. "Darn. That thing is really getting out of calibration. There's just no way we could be burning 34 gallons an hour. I'm going to have to get that thing looked at when I get back home."

Little did I know that my diversion would be for an entirely different reason.

I figured we still had enough fuel to make Waycross with sufficient fuel in reserve to meet the regs, although not within my personal minimums. Yet, I wasn't too happy with the situation.

I really didn't want to divert at this point in the flight. My client was having a hard enough time keeping up with the things that were planned.

Photo by James Williams

Dealing with the unplanned would probably put him over the edge. The fact that the fuel totalizer had always been slightly out of calibration also affected my decision. Such were my thoughts as we flew over several airports where we could have landed and assessed the situation more thoroughly.

Accepting Reality before It's too Late

Here's where human factors really came into play. It's amazing how we can rationalize our way around making proper decisions, letting the pressures of "sticking to the plan" fool us into a sense of invulnerability. Denial had crept into the cockpit. My desire to continue the flight as planned and to avoid stopping at an unknown airport with the potential of being stuck there was keeping me from making the right decisions.

On we flew, with my head, as well as the airplane, in the clouds. When I noticed that the left fuel tank gauge registered one half, even though the fuel selector was still on the right tank, good reason finally prevailed. Waycross was about 65 miles distant, but something was very wrong. "It's not the totalizer that's wrong," I told myself. "Stewart, it's your thinking."

Suspecting a broken fuel line, on my GPS I pulled up the nearest airports page and found that there was an airport about 12 miles off the right wing, except it did not appear to offer fuel. I called Jacksonville Center and requested vectors to the nearest airport, and they immediately turned me toward McRae, which was the one I had found on the GPS. They also cleared me to descend to 3,000 feet.

I had allowed my aeronautical decision making to be influenced by hazardous attitudes and operational errors.

For pilots, there are three things that are completely useless: Runway behind you, altitude above you, and fuel in the truck. We already had one strike against us regarding the fuel in the truck. I wasn't ready to get a second strike by descending, so I told Center that I would stay at our current altitude until we were overhead the airport, or at least within gliding distance to it.

With about five miles to go to the airport, we broke out of the clouds and showers, and made visual contact with the airport. I had taken over the controls as soon as we had started our diversion. I informed my client that now I wanted him to be prepared to exit the airplane as quickly as he could as soon as we landed and had come to a stop. As we got overhead the airport, I cancelled the IFR clearance and started a spiraling descent.

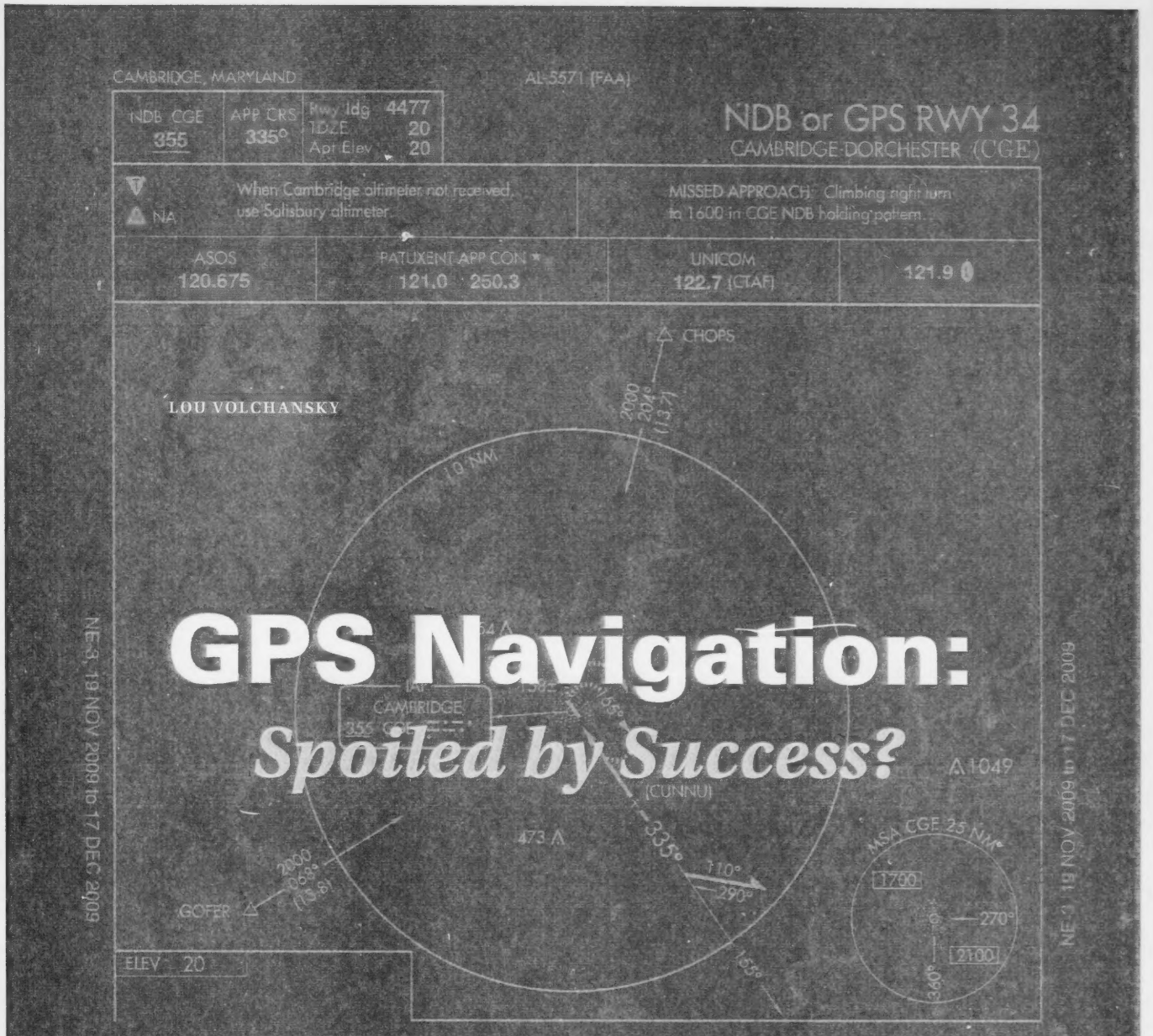
I was planning on a high and tight pattern, for I knew that if the engine quit, once the gear was out, my *Cardinal* would rival a grand piano in its glide. Sure enough, as we turned final, the engine quit. But since my thought processes were finally working properly I didn't find myself out with the third strike. We landed, came to a quick stop, and hurriedly exited the airplane. Fortunately, no fire started, even though there was still a little bit of fuel dribbling out of the broken fuel line.

Don't Count on Luck!

I was very lucky that day. I made some horrendous mistakes that compounded themselves as I flew on. I certainly allowed my aeronautical decision making to be influenced by hazardous attitudes and operational errors. My first mistake was to allow invulnerability to hold sway. I then rationalized too many things: fuel gauges, fuel totalizer, fuel remaining, and distance to go. I allowed some operational errors to get in the way, such as we've got to complete the flight, I've got a client on board, and I can't afford a diversion and possible stranding at a small unattended airport.

But, perhaps the biggest mistake I made that day was to allow denial to sit in the left seat. It took way too long to accept that I had a major problem. "Denial" is not a river in Egypt. It is a very real response, which unfortunately affects many pilots at the worst of times. Had I not been able to overcome my denial that day, the gloom that started the day would have certainly turned into total obscurity. I share this lesson so that you might not be affected by the gloom of denial but instead enjoy blue skies and tailwinds.

Doug Stewart is the 2004 National CFI of the Year, a Master CFI, and a DPE. He operates DSFI, Inc (www.dsflight.com) based at the Columbia County Airport (1B1), New York.



GPS Navigation:

Spoiled by Success?

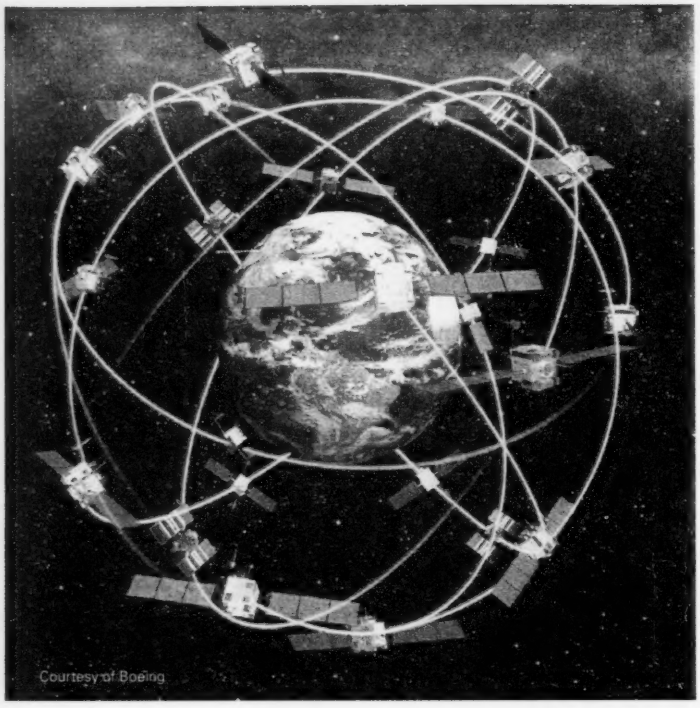
LOU VOLCHANSKY

Whether driving a car or flying an airplane, most pilots today rely on Global Positioning System (GPS) navigation to know where they are and how to get where they want to go. GPS consists of a space segment (24 satellites that orbit the earth every 12 hours), a control segment (ground stations that monitor satellite function and make system adjustments), and user equipment (your GPS receiver).

GPS provides 24-hour worldwide service, highly accurate three-dimensional location information, and precision velocity and timing for global military, civilian, and commercial users. GPS exceeds its minimum constellation performance and service commitments, which is a credit to the U.S. Air Force and its programmers and operators. However, are we spoiled by success? Here's what you, as a pilot, need to know about GPS reliability and its Receiver Autonomous Integrity Monitoring (RAIM) function.

How Does RAIM Work?

Chapter 1, Section 1-19 of the *Aeronautical Information Manual* (AIM) describes GPS and its various functions, including RAIM prediction. IFR-approved GPS receivers use RAIM to provide GPS signal integrity monitoring, sometimes referred to as fault detection. A GPS receiver without RAIM functionality is not able to detect a GPS satellite malfunction. RAIM is necessary since it can take up to two hours before an erroneous satellite transmission can be detected and corrected by the satellite control segment.



An illustration showing the GPS satellite constellation.

In addition to four usable satellites required for navigation, one additional satellite must be in view for the receiver to perform the RAIM function. Therefore, RAIM needs a minimum of five satellites in view, or four satellites and a barometric altimeter (baro-aiding) to detect an integrity anomaly. Baro-aiding is a method of augmenting the GPS integrity solution by using a non-satellite input source. Certain Technical Standard Order (TSO) C129 GPS receivers, and WAAS receivers, have the ability to exclude a failed satellite, sometimes called fault exclusion. RAIM with fault exclusion needs six satellites in view (or five satellites with baro-aiding) to isolate the corrupt satellite signal and remove it from the navigation solution. For RAIM and fault exclusion, the position of the satellites affects how quickly a bad satellite signal can be detected.

Using RAIM and Avoiding GPS Traps

How does this relate to you as a pilot? Ground-based navaids (VOR and ILS) have monitors that can effectively remove a suspect navigation signal from the cockpit by displaying a flag on the navigation instrument. GPS equipment uses RAIM to provide the same indication. Since RAIM is not always available, the user must also have an indication to inform the pilot when the equipment has lost the ability to monitor for error.

In the unlikely event a satellite fails while it is being used by your equipment, the navigation display will be flagged as invalid. In that case, you should revert to other means of navigation. This may be accompanied by a message indicating that RAIM has detected a failure. Since GPS failures of this kind have occurred less than once per year, an individual pilot is unlikely to encounter this situation.

A much more likely event is that the RAIM function is not available due to an insufficient number of available satellites in the right positions. Since the GPS receiver can no longer detect satellite failures that may occur, the AIM recommends that the pilot monitor other navigation equipment or revert to alternate means of navigation.

RAIM and Instrument Approaches

Back in the days when NDB instrument approaches were considered modern technology, pilots had to continuously monitor the Morse code identification of the station to establish that the navigation signal was reliable as they descended through the clouds. When flying a GPS approach, pilots must also ensure that the receiver is providing reliable course guidance to the runway. RAIM must be available.

AIM 1-1-19(g) describes GPS approach procedures. As long as an instrument approach procedure has "GPS" in the title, "underlying ground-based navaids are not required to be operational and associated aircraft avionics need not be installed, operational, turned on, or monitored" although pilots are advised to do so if able.

To ensure that RAIM will be available throughout a GPS approach, the receiver performs a RAIM prediction two nautical miles (NM) prior to the final approach fix, which is referred to as the final approach waypoint in GPS-approach parlance. AIM 1-1-19(i) states that, "if a RAIM failure/status annunciation occurs prior to the final approach waypoint (FAWP), the approach should not be completed since GPS may no longer provide the required accuracy."

If RAIM is not expected to be available throughout the final approach, the equipment will not enter the approach mode. Therefore, the pilot should ensure the receiver has sequenced to "approach" mode prior to the FAWP. If it does not, the pilot should:

- Not descend to the minimum descent altitude (MDA)/decision altitude (DA);
- Proceed to the missed approach waypoint after passing the FAWP; and

FAA's RAIM prediction model uses assumptions about generic aviation grade GPS receiver performance, so your specific receiver may be better. The model uses a generic RAIM algorithm to predict a horizontal protection level (HPL), considering the current and scheduled status of GPS satellites. The HPL is then compared to the alert limit for the phase of flight: en route (2 NM), terminal (1 NM), non-precision approach (0.3 NM), to determine availability. If the HPL is predicted to be greater than the alert limit, an outage of service capability is indicated.

- Perform the published or assigned missed approach and contact ATC.

If the navigation source is flagged after the FAWP, a GPS failure has been detected and the pilot should immediately execute the missed approach.

GPS Preflight Procedures

It is the operator's responsibility to ensure that RAIM availability exists, much like ensuring you have adequate weather conditions for your flight. There are six means to accomplish this task, condensed into three methods below. These are listed in the Notice to Airmen Publications (NTAP), which can be found at http://www.pilotweb.nas.faa.gov/.

1. Perform your own prediction: Monitor the status of each satellite in its plane/slot position, account for the latest GPS constellation NOTAMs, and compute RAIM availability using RAIM-prediction software provided by your GPS receiver manufacturer, or use the actual GPS receiver itself. However, receivers are only required to predict non-precision approach RAIM, so this method is labor intensive. You cannot simply count the number of satellites to assure sufficient RAIM availability will exist. Proper satellite geometry is what matters.

2. Contact an approved source: Use the FAA's en route and terminal RAIM prediction Web site: www.raimprediction.net; or, contact a Flight Service Station (although current information is for non-precision approach RAIM).

3. Use a third party: Flight planning vendors can incorporate the FAA/Volpe RAIM prediction data without altering performance values to predict RAIM availability for the aircraft's predicted flight path and times. Certain flight planning vendors also have FAA approval to provide similar RAIM data.

What Does "UNRELIABLE" Mean?

The term "UNRELIABLE" is used in NOTAMs in conjunction with regions/times where interference to GPS is likely. This information should be used during flight planning so that the loss of GPS in the indicated area does not disrupt the operation. While in flight, GPS may continue to be used as long as the equipment continues to provide navigation guidance. Air traffic control will advise pilots requesting a GPS or RNAV (GPS) approach of GPS UNRELIABLE NOTAMs not contained in the ATIS broadcast, as well as pilot reports of GPS anomalies received within the preceding 15 minutes. When GPS is lost in an area indicated as "UNRELIABLE" in a NOTAM, the pilot does not need to report the loss of GPS to ATC. Outside of such areas, reporting a GPS outage is important in identifying and resolving any interference.

Advisory Circular 90-100A, U.S. Terminal and En Route Area Navigation (RNAV) Operations, discusses RAIM prediction in more detail for terminal (RNAV 1) procedures and en route (RNAV 2) operations. Pilots who use GPS for IFR navigation should review and be familiar with this advisory circular.

What about WAAS?

AIM 1-1-20 describes the Wide Area Augmentation System (WAAS). With WAAS, strategically positioned ground-reference stations monitor GPS satellite signals and correct any errors in the data that can result from atmospheric anomalies. This "cleaned-up" version of GPS data is sent back to the GPS satellite network and then rebroadcasted. A WAAS-enabled GPS receiver (TSO-C145 or C146) uses this version of the GPS signal to provide more accurate position data,

making RAIM prediction unnecessary in these units. In addition to providing the correction signal, a WAAS geostationary satellite provides an additional range measurement to the GPS receiver, improving the availability of GPS by providing, in effect, an additional GPS satellite in view.

One of the key advantages of a WAAS-enabled (Class 3 or 4) GPS receiver is the ability to fly a GPS instrument approach with vertical guidance. According to the AIM, "this WAAS generated angular guidance allows the use of the same TERPS approach criteria used for ILS approaches. The resulting approach procedure minima, titled LPV (localizer performance with vertical guidance), may have a decision altitude as low as 200 feet height above touchdown with visibility minimums as low as a half mile."

We've been spoiled by the success of GPS, but we should not become complacent about its reliability.

A WAAS-enabled GPS receiver will display "LPV" if WAAS is available for a given GPS approach. However, pilots who plan to use a WAAS-enabled GPS receiver for IFR flight need to be on the lookout for NOTAMs indicating that WAAS is "UNRELIABLE" or "UNAVAILABLE." If the WAAS signal is not available during the approach, the GPS unit will display the best minimum it can offer without WAAS. This is typically LNAV, which provides GPS lateral guidance only.

Outside of WAAS coverage, TSO-C145/C146 receivers operate using RAIM in a manner similar to TSO-C129 and TSO-C196 GPS equipment. TSO-C196, *Airborne Supplemental Navigation Sensors for Global Positioning System Equipment Using Aircraft-Based Augmentation,* is a new standard describing receivers encompassing many of the technical performance improvements in WAAS-enabled receivers, but not including the WAAS (also known as satellite-based augmentation system, or SBAS) technical requirements and WAAS operational advantages.

Gold Standard

For pilots, GPS navigation is the "gold standard" for accuracy and reliability.

The current GPS constellation continues to provide outstanding service, and the operational approvals associated with GPS take advantage of those capabilities. Appropriate flight planning is important to ensure that on any given day GPS can support a given operation. Remember, accuracy isn't the only performance issue: integrity is just as important. For TSO-C129 equipment, RAIM provides a means of integrity. Satellite position is critical to RAIM predictions, not simply the number of operational satellites. For RNAV 1 and RNAV 2 operations, AC 90-100A provides guidance on when RAIM availability must be confirmed.

We've been spoiled by its success, but we should not become complacent any more than we should ignore the possibility of an engine failure on takeoff. When navigating using GPS—especially under IFR—remain vigilant and know where your system displays GPS signal integrity. It will help you get to where you want to go.

Lou Volchansky is an aerospace engineer in the FAA Aircraft Certification Service Avionics Systems Branch and a pilot who frequently flies GPS approaches.

For More Information

Aeronautical Information Manual
http://www.faa.gov/air_traffic/publications/

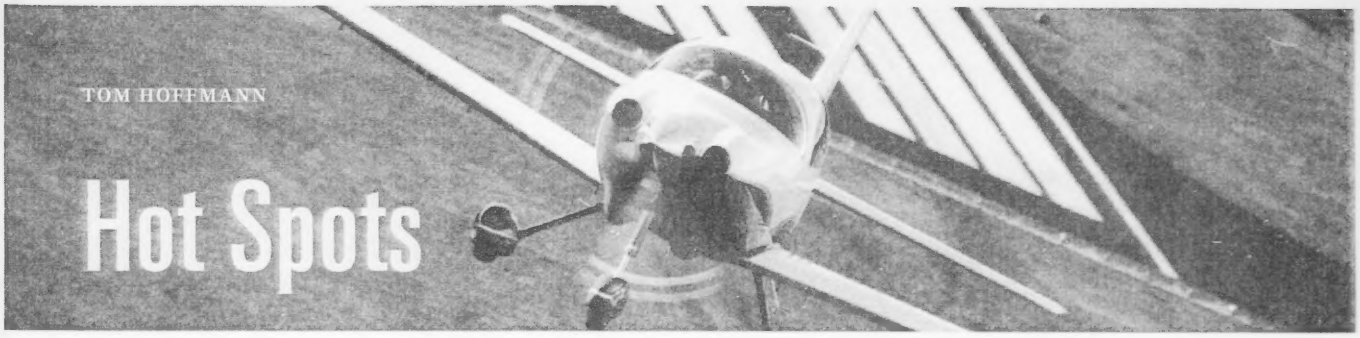
FAA Navigation Services Web Site
http://www.faa.gov/about/office_org/headquarters_offices/ato/service_units/techops/navservices/gnss/

FAA RAIM Prediction Web Site
http://www.raimprediction.net/

Global Navigation Satellite System (GNSS) Library, Frequently Asked Questions
http://www.faa.gov/about/office_org/headquarters_offices/ato/service_units/techops/navservices/gnss/faq/gnss/

GPS from the Ground Up, AOPA Safety Advisor
http://www.aopa.org/asf/publications/sa01.pdf

GPS Frequently Asked Questions
http://gps.gov/public/faq.shtml



TOM HOFFMANN

Hot Spots

Deciding Your Fate

Don't Deviate from Good Decisions

Life is full of day-to-day decisions. Which shoes do I wear to work? Should I take the freeway or the back roads? Do I want coffee or tea? Chicken or beef? These are just some of the daily choices we make, usually without much thought or consequence (although freeway traffic is never much fun when you need to be somewhere).

External factors, such as time, money, and emotional state, can all play important roles in how we make our decisions. Personal experience and habits also factor into the process and, based on how well you apply lessons learned, that can either be a good or bad thing. While the consequences of some common day-to-day decisions may only result in being late for an appointment or eating a meal that's not appetizing, decision-making skills in the flying world can render more serious consequences and unexpected results. Consider the following scenario.

Gone Fishin'

It's Friday night and after a grueling week at work you look forward to taking your flying club's new *Cirrus* to meet friends for a Saturday morning fishing trip. The forecast calls for "severe clear" and light winds in the morning, with the possibility of storms later that afternoon. Sounds like a good plan for an early flight. However, as can be expected—and by all means it should—not all things go according to plan.

That grueling work week triggered several consecutive restless nights with at best 25 hours of sleep for the week. You decide to make up for it and hit the hay early—good idea! That is until your child comes to you with a Scout project that takes half the night to complete. While you're busy perfecting your birdhouse-building skills, you begin to feel congested and your throat seems a tad scratchy. You pop an aspirin before turning in.

Waking up late the next morning, your plans for a good breakfast and a detailed weather briefing are disrupted. Instead, you grab some coffee, a banana, a package of tissues for your worsening cold symptoms, and perform a quick overhead scan only to see miles of brilliant blue. You head off and hope not to keep your friends waiting too long.

Arriving at the airport, you discover the stormy front is expected to move through sooner than previously forecast. Instead of hanging up your headset and calling it a day, you press on, hopeful to squeeze in a couple hours of fishing and return before the weather worsens.

Throwing your flight bag and tackle box in the back of the plane, you complete your pre-flight, scratch down information Charlie from ATIS, and request taxi clearance. Within seconds the controller responds, "Cirrus 123, taxi to runway 18R." You begin your taxi as you blaze through your remaining checklist items, set up your frequencies, and ponder how a fresh fish dinner will taste tonight.

Utilizing available resources is one way to break that chain and help mitigate the risk to you and your passengers.

During this flurry of last-minute activity, as well as a brief fit of sneezing, you neglect to hear an unexpected instruction from ATC to hold short of the parallel runway 18L for landing traffic. Luckily, your eyes catch the traffic on final, but only seconds before your plane reaches the hold-short lines. You narrowly escape what could have been a deadly runway incursion.

Stop and Read the Signs

Before this pilot even left home, we can see a trail of bad decisions. Do you recognize any that you may have made? Stress, fatigue, illness, and get-there-it-is all played a part in this scenario, which could have turned ugly fast. All too often pilots overlook these perilous signs. Individually, they may not seem all that bad, but in concert, they can be deadly.

In the NTSB's 2005 Annual Review of U.S. General Aviation Accident Data, 36 percent of accidents with a human factors cause were attributed to planning and decision making. On a broader scale, it's estimated that nearly 80 percent of

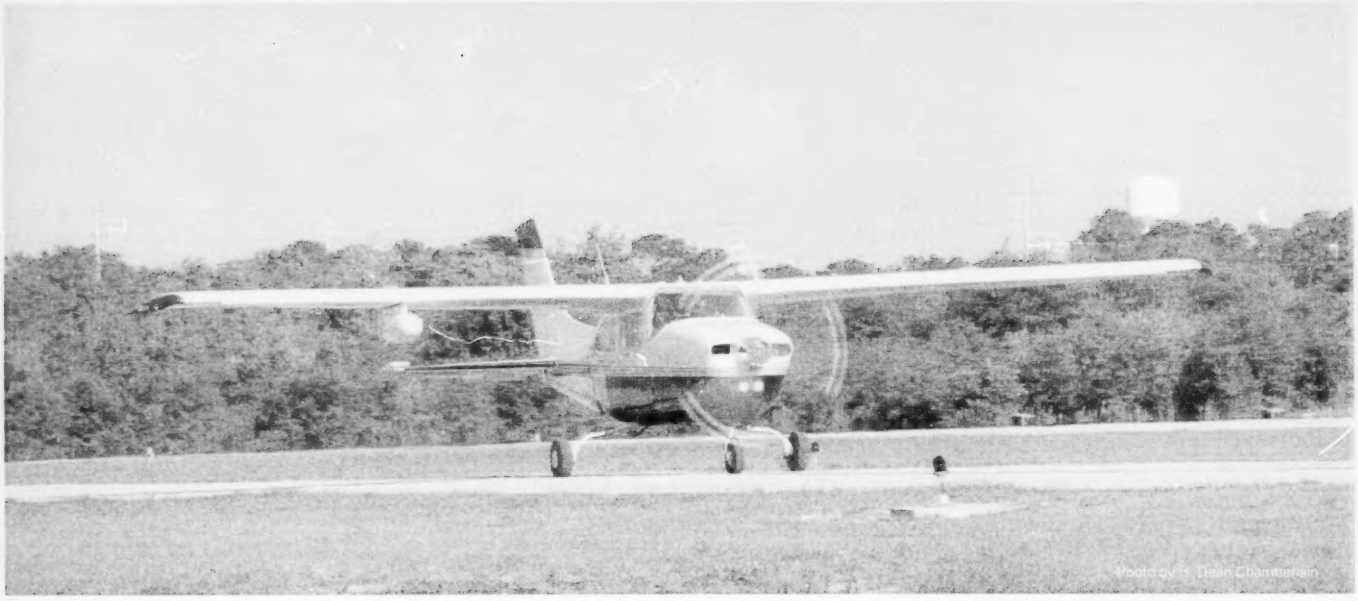


Photo by H. Dean Chamberlain

The Three P's

FAA adopted a three-step model to aid pilot decision making and mitigate risk.

Perceive: Identify hazards, which could be events, objects, or circumstances that could contribute to an undesired event.

Process: Do these hazards pose a risk? Evaluate their level of impact on safety.

Perform: Take the best course of action to eliminate the hazard and evaluate the outcome.

all aviation accidents are human factors related, with a large part of those stemming from bad decisions.

This information illustrates our vulnerability to the hazardous attitudes and basic human limitations that affect how we react to certain situations. Complacency and carelessness have a way of creeping up on pilots so that it takes a concentrated effort to steer yourself in the right direction. Throw in some distractions and unexpected events and it can be a recipe for disaster. That's why recognizing the consequences of your decisions *before* you take action is so important.

As can be expected—and by all means it should—not all things go according to plan.

The pilot in the example had several clues that perhaps it was not the best day to fly. Lack of sleep, ailing health, running behind schedule, and impulsive behavior all contributed to a series of bad decisions.

Using available resources is one way to break that chain and help mitigate the risk to you and your passengers. These resources range from your own knowledge and personal piloting skills, to the helpful folks at ATC and flight service stations who can provide vital information on traffic, weather, airport conditions, and more. By tapping these resources, in addition to heeding the warning signs that can impede good judgment, you'll be well on your way to making more good decisions.

Tom Hoffmann is associate editor of FAA Aviation News. He is a commercial pilot and holds an A&P certificate.

For More Information

Aeronautical Decision Making (ADM) video on FAASafety.gov
http://www.faasafety.gov/gslac/ALC/libview_search.aspx?id=562&keywords=adm

Pilot's Handbook of Aeronautical Knowledge: Chapter 17, ADM
http://www.faa.gov/library/manuals/aviation/pilot_handbook/media/PHAK%20-%20Chapter%2017.pdf

GA Pilot's Guide to Preflight Weather Planning, Weather Self-Briefings, and Weather Decision Making
https://www.faasafety.gov/files/gslac/library/documents/2006/Oct/9724/GA%20Weather%20Decision-Making%20Aug06.pdf

AOPA Air Safety Foundation Interactive Course "Do the Right Thing: Decision Making for Pilots"
http://flash.aopa.org/asf/decisionmaking/dttt.cfm

AOPA Air Safety Foundation Safety Advisor – "Do the Right Thing: Decision Making for Pilots"
http://www.aopa.org/asf/publications/sa24.pdf

KATRINA E. AVERS AND WILLIAM B. JOHNSON

Nuts, Bolts, and Electrons

Fatigue Survival Toolbox

Would you go into the desert without water? Unless you're part camel, the obvious answer is "no" since we all know how important water is for survival. However, this same acknowledgment of a life-sustaining necessity doesn't always seem to apply to sleep with the same level of urgency. Going to work without adequate sleep is like going into the desert without water: It is dangerous!

Yet, it's startling how few of us actually get the required winks needed each night and come to work fatigued time and time again. Recognizing this, the FAA created several new tools for aviation maintenance technicians (AMT) to heighten awareness of this vital issue and to help keep the dangerous consequences of fatigue at bay.

A Few Keys to Survival

Some in the aviation industry continue to see fatigue as a normal and unavoidable part of aviation maintenance. They consider that with enough effort, tired workers can continue to perform their jobs effectively. However, the evidence shows that fatigue has a very real detrimental impact on not only your personal safety, but also flight safety. Fatigue is a known contributor to on-the-job mishaps, personal injury, poor personal health, injury to others, and the quality of your family and social life.

To be fully prepared for long work days, night work, and an unpredictable schedule, you need to be aware, plan, and take action. FAA has put together several new tools to help. Key among them is a 2010 pocket calendar for AMTs entitled Fatigue Survival Toolbox. The portable calendar identifies and features 12 critical issues that can influence fatigue and provides you with the tools necessary to combat fatigue both on and off the job.

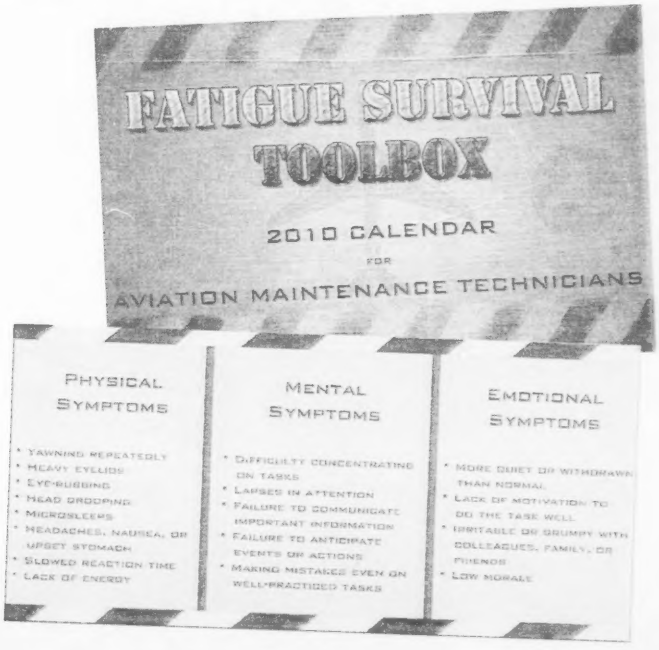
Be Aware

The first step to surviving fatigue is recognizing that fatigue is not something you can just "work through." You must recognize that fatigue is a hazard that can lead to increased errors and greater safety risks. Most of us cannot accurately assess when we are fatigued. However, there are a number of physical, mental, and emotional symptoms to help determine if fatigue has become a safety risk. By reviewing the list of symptoms provided in the calendar and listed below, you'll have a good idea if you may be experiencing some level of fatigue or reduced alertness. If you exhibit fatigue-related symptoms regularly, you should consider seeing a doctor.

The first step is recognizing that fatigue is not something you can just "work through."

Planning Is Important

Most of us would not even think of going into the desert without a plan, yet many of us only think of the next thing that has to be done in our daily lives. To have quality of life, we must plan and set aside time for sleep, work, family, and friends. We must prioritize our time and prepare in advance. For example, you probably shouldn't plan to perform a complex maintenance activity on a Friday night after you have worked a full day, run errands, mowed


FATIGUE SURVIVAL TOOLBOX
2010 CALENDAR
FOR
AVIATION MAINTENANCE TECHNICIANS
PHYSICAL SYMPTOMS
• YAWNING REPEATEDLY
• HEAVY EYELIDS
• EYE-RUBBING
• HEAD DROPPING
• MICROSLEEPS
• HEADACHES, NAUSEA, OR UPSET STOMACH
• SLOWED REACTION TIME
• LACK OF ENERGY
MENTAL SYMPTOMS
• DIFFICULTY CONCENTRATING ON TASKS
• LAPSES IN ATTENTION
• FAILURE TO COMMUNICATE IMPORTANT INFORMATION
• FAILURE TO ANTICIPATE EVENTS OR ACTIONS
• MAKING MISTAKES EVEN ON WELL-PRACTICED TASKS
EMOTIONAL SYMPTOMS
• MORE QUIET OR WITHDRAWN THAN NORMAL
• LACK OF MOTIVATION TO DO THE TASK WELL
• IRRITABLE OR GRUMPY WITH COLLEAGUES, FAMILY, OR FRIENDS
• LOW MORALE

the lawn, and helped put the kids to bed. Although you may think you are okay to do the job, your body's internal clock will be telling your brain to go to sleep. The bottom line: We must be aware of our limitations and plan accordingly.

Take Action

Planning is effective only if it is paired with action. So, don't delay—request a copy of the Fatigue Survival Toolbox calendar now. Ask your local FAASTeam Program Manager (FPM) for details. You can identify your FPM by going to www.FAASafety.gov, then go to the "Directory" where you can search for the appropriate person to contact.

Evidence shows that fatigue has a very real detrimental impact on not only your personal safety, but also flight safety.

In addition to the calendar, there are other tools that can help guide your plan of action against fatigue. An FAA workgroup involving scientists, mechanics, and regulators recently launched a new fatigue section of the Maintenance Human Factors Web site, along with a new fatigue-focused newsletter for AMTs. Both of these are available at www.mxfatigue.com.

Even with these fatigue identification and risk mitigation tools available, the most powerful and direct way to confront fatigue is individual responsibility. Now, get some sleep!

Katrina E. Avers, Ph.D., is a research scientist in the Human Factors Research Division at FAA's Civil Aerospace Medical Institute. Her research focuses on organizational assessment, fatigue education, fatigue reporting systems, and fatigue risk management programs for flight crew, cabin crew, and maintenance technicians.

William B. Johnson, Ph.D., is FAA Chief Scientific and Technical Advisor for Human Factors in Aircraft Maintenance Systems. He joined FAA in 2004 after 30 years of private sector experience in academia, safety engineering consulting, and airline/MRO training. He is an Aviation Maintenance Technician and a 40-year pilot.

Coming Soon:
FAASTeam Safety Stand Down
FAA Safety Team – FAASTeam –
is standing down for safety on April 17, 2010.
Stay tuned to www.FAASafety.gov to learn more about FAASTeam Safety Stand Down and see the article on page 3.
FAAST
Federal Aviation Administration
SAFETY TEAM

Flight Forum

Sharing Dates

I've been an active flight instructor since 1984 and I'm trying to find out the dates for when the airspace changed from TCA and ARSA to Class B and C? And, when the METAR and TAFs started to be used for briefings?

Any help you can give me is appreciated.

—Yuzo Wakita

The reclassification of the National Airspace System happened on September 16, 1993. As for METAR/TAF, that was initiated on June 1, 1996.

Armed Airplane

There is an error in one of the captions in the STC compatibility article (November/December 2009). The photo of the *Champ* is captioned, "An example of an STC to mount a rifle case to an airplane." An STC is not required to install provisions for a rifle scabbard, The aircraft actually does include many other STC'ed modifications, but the rifle scabbard is not one of them.

—Della Swartz

Anchorage Aircraft Certification Office (ACO)

Thanks for writing the article and for providing this clarification.

Kudos on College Park

I flipped through the September/October 2009 issue and was most interested by the article on College Park Airport. Although I had been to AirFaire celebrating the airport's 100th anniversary and read other items on the Web, I read the article through because it included items I didn't know. I particularly appreciated the box on page 29 which lists the security steps needed to fly into College Park and I guess the other two "DC-3" airports (Potomac Airfield and Washington Executive/Hyde Field). I think it would be super to have access to that airport and be able to walk to the Metro (subway) station and then whiz to any part of Washington, DC, and will see about getting my PIN.

—DeWitt Whittington

We are glad you enjoyed the article and the information was helpful.

Tires and Runway Safety

I have a comment on your SAFO on Tire Safety article in the September/October issue's ATIS. It reminded me of something that happened in 2008. We landed at KSHD (Shenandoah Valley Regional Airport) and immediately discovered that we had a flat on one of the main gears (Cessna-172S). Luckily, we were able to turn off the runway onto a taxiway and the tower sent a maintenance truck out to change the flat. Afterwards, we realized that if this had happened at an uncontrolled airport or after the tower had closed and if we had not been able to get off the runway we would probably have not known what to do. There would have been a risk of our still being on the runway and incoming traffic not being aware of it. We are both low time (120 hours) pilots so many situations are entirely new to us. An article on "being stuck on the runway" in an uncontrolled/closed tower airport might be a good future subject for magazine.

Thanks for the information.

—Doug Toppin

We are glad things turned out okay in your emergency situation. We are always looking for story ideas, so thanks for the article idea.

FAA Aviation News *welcomes comments. We may edit letters for style and/or length. If we have more than one letter on the same topic, we will select one representative letter to publish. Because of our publishing schedules, responses may not appear for several issues. We do not print anonymous letters, but we do withhold names or send personal replies upon request. Readers are reminded that questions dealing with immediate FAA operational issues should contact their local Flight Standards District Office or Air Traffic facility. Send letters to: Editor, FAA Aviation News, AFS-805, 800 Independence Avenue, SW, Washington, DC 20591, or FAX them to (202) 267-9463, or e-mail AviationNews@faa.gov.*

SUSAN PARSON

The Legacy of Echo Sierra

In your travels around America's general aviation airports, you may have spotted a post-1994 Cessna *Skyhawk* whose tail number ends with the letters "ES"—Echo Sierra. There are 100 airplanes bearing those initials, because Cessna chose that very appropriate way of honoring Ed Stimpson, the man who spearheaded passage of the landmark General Aviation Revitalization Act of 1994 (GARA) during his 25-year tenure as president of the General Aviation Manufacturers Association (GAMA).

Whether or not you were flying at that time, Ed Stimpson and GARA affected your aviation life. Passage of this legislation paved the way for Cessna and other manufacturers to restart production of small general aviation aircraft. It also opened the door for new companies, such as Cirrus and Diamond, to introduce "clean-sheet" designs that incorporate the kind of human factors elements and technologies discussed in this issue. It is thus especially fitting to pay tribute here to Ed, who recently passed away after a courageous battle with cancer.

There is no segment of aviation that Ed Stimpson didn't touch in his achievement-filled lifetime.

A Class Act

There is no segment of aviation that Ed, a private pilot, didn't touch in his achievement-filled lifetime. While working in the State Department's international aviation policy office, I was privileged to meet Ed at GAMA in the early 1990s. I no longer remember the issue that took me to his office, but I will never forget how he lit up with enthusiastic encouragement when he learned that I was a newly-certificated pilot. Anyone who loved aviation found an instant friend and supporter in Ed Stimpson and, no matter how pressing our official business, he never failed to ask about my flying. I remember thinking how appropriate it was for Ed to be named chairman of Be A Pilot when he retired from GAMA in 1996.

A Natural Diplomat

Our paths crossed again in 1999, when then-President Clinton appointed Ed to serve as the U.S. Ambassador to the International Civil Aviation Organization (ICAO) in Montreal. Still at State, I had the pleasure of working with him on a near-daily basis. Though not a "professional" diplomat, Ed's bonhomie and gift of gab made him a natural. I don't think there was anyone in ICAO who didn't know and love Ed, and he returned the favor. I was always amazed by how he could greet everyone we passed by name. That personal touch—his special gift—made him effective not only in Washington, but also on the international stage. On September 11, 2001, I was on the phone with Ed when we both learned of the terrorist attacks. His knowledge, experience, and steadiness were key to navigating the turbulent times following that terrible day.

An Aviation Citizen and Statesman

Ed eventually retired from his ICAO post and went home to Idaho, but he never retired from aviation. He chaired the Flight Safety Foundation and served on the board of Embry-Riddle Aeronautical University and, most recently, on a DOT-appointed Independent Review Team to evaluate the effectiveness of FAA's safety oversight.

Although cancer cruelly robbed Ed's family and extended aviation family of his energy, enthusiasm, and unparalleled effectiveness, the legacy of Echo Sierra lives on—and flies proudly on the empennage of 100 "extra special" *Skyhawks*.

Susan Parson is a special assistant in the FAA's Flight Standards Service. She is an active general aviation pilot and flight instructor.

JAMES WILLIAMS

FAA Faces

Keep a Smile on your Face...

"My mother always said 'Keep a smile on your face and your big mouth shut.' I've always been good at the first part."

You'll be glad he's not so good at the other part. As team leader of the Civil Aerospace Medical Institute's (CAMI) Airman Education Programs, Rogers V. Shaw II wants to help you fly safely. The program Shaw leads provides training, lectures, and even DVDs on human factors topics of great interest to most GA pilots.

Always a New Challenge

Rogers (his first name, not his last) Shaw started his aviation career as a U.S. Air Force pilot flying the C-7 *Caribou* and later the B-52 *Stratofortress*. He moved to the UH-1 *Iroquois* (Huey) to finish his Air Force flying career. When the Air Force retired his aircraft, he moved to a new challenge that would set him up for another career. "In '89 the Air Force was looking for a rated pilot to serve at the altitude chamber at MacDill Air Force Base," Shaw said. "They were having problems with pilots transitioning to the new F-16s and needed someone who could help with the human factors issues the new aircraft presented."

A few years later, as Shaw prepared to retire from the Air Force, he saw a similar opportunity at CAMI's altitude chamber. He still works at the CAMI altitude chamber, but he does so much more. In addition to conducting training for pilots in the altitude chamber, Shaw teaches courses at the FAA Academy and to the public. He gives lectures at air shows and other aviation events. Some of his favorite topics include fatigue, stress, pilot attitudes, and automation. "Initially, I thought pilots were our only audience, but we've found that these problems and concepts apply just as well to flight attendants, ATC, maintenance, and operational personnel."

Shaw wishes more airmen knew about the program. "We visit air shows and events every year to get this information out, but we still need to reach more people." The Airman Education Programs (www.faa.gov/pilots/training/airman_education/) provides information as well as videos (available via DVD and the Internet) on aviation physiology and aviation survival. "We're also working on some new videos on other human factors topics," Shaw said. "We are working with the FAASTeam to launch online courses based on our materials covering physiology, human factors, and the *Pilot Medical Handbook*." He continued, "Pilots will be able to take these courses online for WINGS credit."

Photos by Michael Wayda

Rogers Shaw and the Airman Education Programs team

Yet, the real gems of the program are the courses available at CAMI. "We have one-day courses in aviation physiology and basic survival—and they're free." The aviation physiology course covers basic physiology for flight, spatial disorientation, and an altitude chamber flight to experience hypoxia symptoms in a controlled, safe environment. The physiology course does have certain medical requirements, which are listed on the Web site. The basic survival course covers survival in desert, arctic, and water environments from two perspectives: preflight preparation and the skills needed to endure those extremes. Depending on equipment availability, the survival course also includes a hands-on portion that covers fire starting, signaling, thermal (cold) chamber, ditching tank, underwater egress trainer, and an aircraft emergency evacuation (smoke) simulator.

"I wish more pilots knew about our altitude chamber training."

"It's when we rush and let time pressures influence our decisions that we make mistakes."

Shaw says the best advice he can give GA pilots is: "Know your limitations. It's when we rush and let time pressures influence our decisions that we make mistakes."

James Williams is the FAA Aviation News' assistant editor. He is also a pilot and ground instructor.

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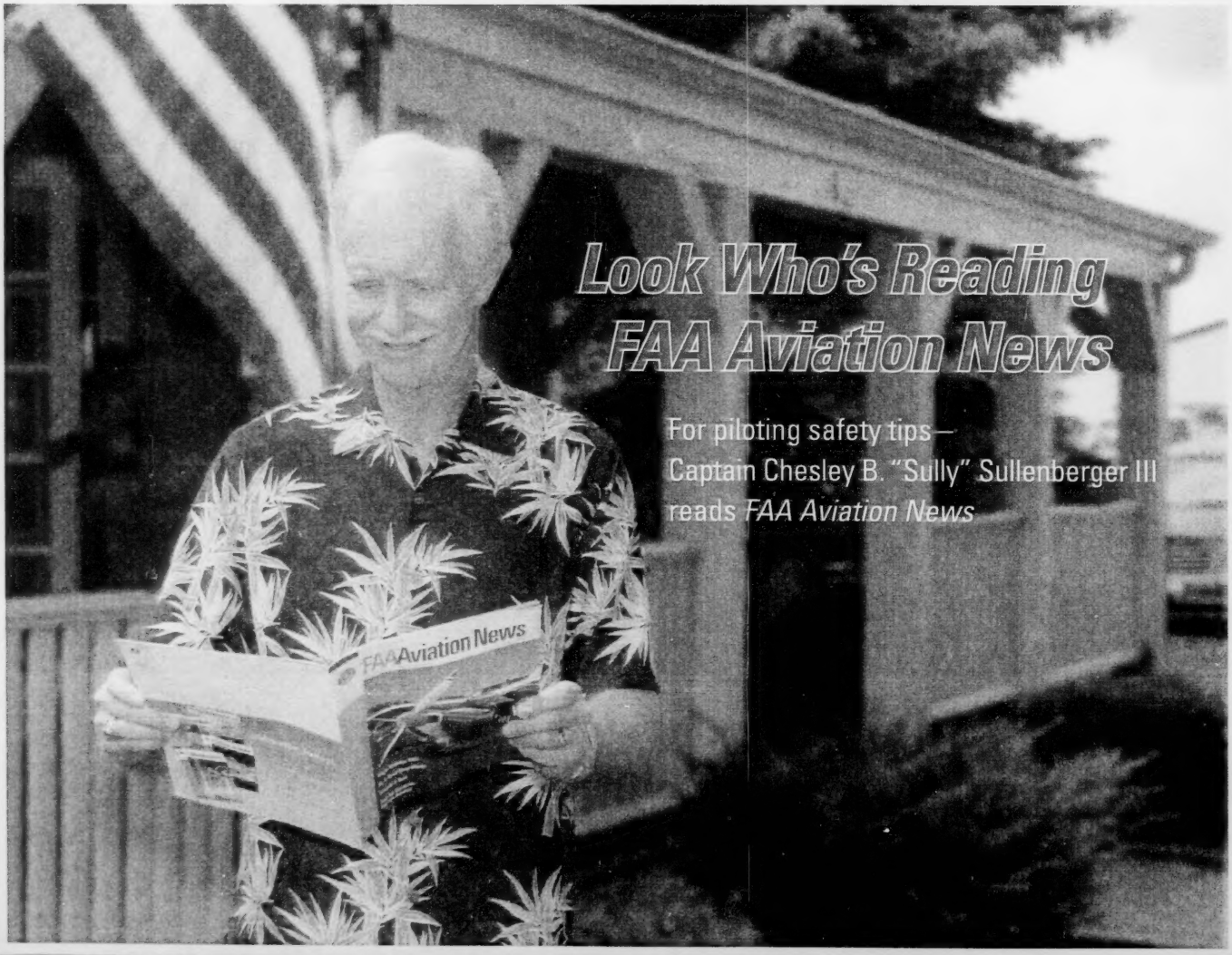
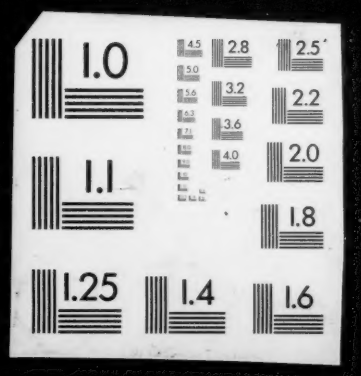


Look Who's Reading FAA Aviation News

For piloting safety tips—
Captain Chesley B. "Sully" Sullenberger III
reads *FAA Aviation News*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